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Identification of Crew- and Platoon-Level Gunnery Subtasks: Objectives for a Threat-Based Training Program

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Human Resources Research Organization

for

Contracting Officer's Representative
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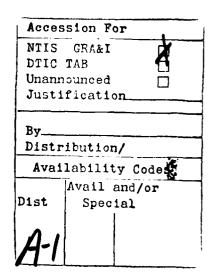of the Deputy Chief of Staff for Personnel

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The purpose of this report was to develop and apply methods for identifying training objectives for threat engagement scenarios derived in previous research (R. Campbell, & C. Campbell, 1989; Doyle, 1989). Rational methods were used to identify a list of crew- and platoon-level subtasks to serve as training objectives. A review against existing task documentation revealed that the list was a comprehensive collection of gunnery behaviors. Cluster analyses reduced the numerous crew-level subtasks to eight categories that differed with respect to fidelity requirements, functional subgoal, and skill requirements. These subtask categories were named: (a) Manipulation of Gun Controls, (b) Tank Commander Engagement Control Procedures, (c) Target Acquisition, (d) Immediate Action, (e) Switch Setting Procedures, (f) Fire Commands/Reports, (g) Degraded Modes, and (h) Maneuver Tank. Crossindexing of subtasks to threat engagement scenarios in which they might be trained revealed a difference between individual/crew and collective subtasks: While most individual and crew subtasks could be trained in all   (Continued)

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or nearly all threat engagement scenarios, most collective subtasks were associated with some but not other scenarios. The researchers concluded that the threat scenario conditions were important drivers for collective subtasks, whereas nonthreat conditions (e.g., hardware conditions) were more important for determining whether individual and crew subtasks could be trained.

IDENTIFICATION OF CREW- AND PLATOON-LEVEL GUNNERY SUBTASKS:
OBJECTIVES FOR A THREAT-BASED TRAINING PROGRAM

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IDENTIFICATION OF CREW- AND PLATOON-LEVEL GUNNERY SUBTASKS: OBJECTIVES FOR A THREAT-BASED TRAINING PROGRAM

Chapter 1

Introduction

Military Problem

The Army has a continuing research need to investigate the effects of and tradeoffs among alternative devices and strategies for training gunnery skills. The present report is one in a series that concerns the development of research tools for supporting this research. Previous work in this series included the development of methods for determining valid threat engagement scenarios for training gunnery skills (R. Campbell, & C. Campbell, 1989), and a detailed description of the scenarios resulting from using these methods (Doyle, 1989). These threat scenarios described key engagements that are likely to occur within the context of the execution of various red/blue mission combinations. The detailed scenario information included the specification of the number, type, and range of likely threat vehicles. The purpose of the present report is to develop and apply methods for determining the objectives for training gunnery skills that are appropriate to these scenarios.

Research Issues

Perhaps the obvious candidates for training objectives are the gunnery tasks from the Master Task List prepared by the Armor School's Directorate of Training and Doctrine. Examination of this list revealed tasks that included many complex behaviors, e.g., "Engage Targets with the Main Gun from Gunner's Station on an M1/M1A1 Tank" (Task No. 171-126-1036). Basing training objectives on such whole tasks is clearly absurd from the standpoint of both training development and skill acquisition. On the other hand, it is equally absurd to organize training around individual performance elements that make up these tasks (e.g., position a particular switch). Instead of either extreme, gunnery training objectives should be organized at some intermediate level of task organization (Hoffman & Morrison, 1988). In the present report, this intermediate unit of behavioral organization is referred to as the "subtask." One goal of the present research was to more clearly define the concept of the subtask.

Morrison and Goldberg (1982) provided methods for rationally parsing procedural tasks into subtasks and their lower level behavioral elements. They described their method as a combination of "top-down" and "bottom-up" analyses. From the top, overall task goals were segmented into subgoals. These subgoals and the behaviors required to accomplish the subgoals defined the subtask level. Subtasks could be further subdivided into "sub-subtasks" as needed, creating a hierarchical structure. From the bottom, individual behavioral elements were grouped into meaningful clusters related to some task subgoal. The clusters also defined subtasks. The two approaches to identification of subtasks were complementary and were intended to be mutually

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confirming. Given the extent and complexity of armor gunnery, it was not likely that the top-down and bottom-up analyses would always generate an identical list of subtasks. To reconcile those potential differences, it was necessary to define more clearly what constitutes a subtask.

Tasks and subtasks are similar concepts in that they both refer to groups of related interrelated behaviors that occur closely in time to accomplish some task goal or subgoal (Miller, 1967). Therefore, the characteristics of a subtask must be the same as that of a task. In that regard, Fleishman and Quaintance (1984) indicated that applied psychologists have defined tasks in different ways. For instance, researchers have defined tasks on the basis of characteristics that are external to the performer such as the stimuli controlling performance (Hackman, 1968). Other researchers have identified tasks in terms of their internal, information processing requirements (Levine & Teichner, 1973). Still other researchers have used type of criterion measurement to distinguish tasks (Teichner & Whitehead, 1973). Rather than choosing one of these criteria over the other, the present analysis used a combination of criteria to aid in identifying gunnery subtasks.

The number of identifiable subtasks related to complex performance domains such as gunnery is likely quite large. This is particularly true at the crew level of analysis. It is often useful to systematically organize such complex domains to conceptually simplify the description and to underscore relationships among its elements. One approach to organization is to form clusters of related subtasks. In addition to simplifying the descriptions, the organization of subtasks into clusters may provide an appropriate structure for training. That is, clusters can identify groups of homogeneous subtasks that can be trained as separable units of instruction using a particular training medium or device. With a similar goal in mind, Boldovici, Harris, Osborn, and Heinecke (1977) clustered armor subtasks on the basis of a set of binary descriptors. A total of 36 descriptors were organized into four subsets: (a) initiating and maintaining stimuli; (b) tools, instruments, and controls; (c) learning processes; and (d) overt responses. The results indicated that the cluster analysis techniques were successful in identifying similarities among subtasks. Boldovici et al. concluded that cluster analysis techniques provided useful input into the training design process. Capitalizing on lessons learned from that research, these techniques were modified to cluster gunnery subtasks in the present research.

At a basic level, the gunnery training objectives must address the individual and crew skills required to operate a tank in a tactical environment. It must also be noted that in a tactical environment tank crews do not fire and maneuver on an individual basis; rather, the tank crews act in concert to execute collective missions. As the smallest tactical maneuver element, the platoon is the lowest level at which maneuver collective functions are identified. Three key platoon collective functions can be identified: First, the platoon must perform tactical movement as a unit. Second, it must distribute and control its firepower as a unit. And finally, it must communicate and coordinate both internally and externally. The platoon performs these functions by accomplishing a series of interactive or

collective tasks and subtasks, enabled by the performance of the individual tanks, and directed and controlled by the platoon leadership (i.e., the platoon leader and the platoon sergeant). The platoon's activities in employing tactical movement, firepower, and coordination can be specifically directed by the platoon leadership or can take the form of drills and SOPs, planned and practiced well in advance of their execution. In either case, both the leadership tasks and the platoon collective tasks are essential and critical complements to the individual and crew gunnery tasks identified previously. Therefore, the gunnery objectives must also include platoon-level as well as crew-level subtasks.

Research Objectives and Report Organization

The overall purpose of the present research was to identify gunnery crew- and platoon-level subtasks to serve as appropriate training objectives for threat-based engagement scenarios. The methods for and results from the analyses of crew- and platoon-level subtasks were quite different; therefore, the two sets of analyses are described separately in the second and third chapters of this report. The fourth chapter describes the relationship between the identified objectives and the threat engagement scenarios that had been derived in previous research in this series. This information was important to the specification of appropriate conditions for training as well as for testing. It was also important to provide a check on the comprehensiveness of the derived subtasks. A fifth and final chapter provides some brief conclusions.

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Chapter 2

Crew-level Objectives

Crew-level objectives were defined as those pertaining to individual and crew subtasks that are required to operate a tank in a tactical environment. It is commonly thought that crew-level objectives form the basic skills of gunnery training.

Analytic Method

The procedure for determining and organizing crew-level subtasks consisted of three activities, which are described in the following sections.

Identification of Gunnery Subtasks

The process of identifying subtasks may be described as a combination of a "top-down" analysis of task goals and a "bottom-up" analysis of individual behaviors (Morrison & Goldberg, 1982). Starting from the top, 13 major subgoals were used to organize the domain of crew gunnery behaviors. These subgoals, listed in Table 1, were modifications of the major tactical gunnery activities identified by Hoffman and Morrison (1988) with the addition of three activities that were subsequently identified as missing from their analyses: (a) Engage Targets from Loader's Station, (b) Take Immediate Action, and (c) Employ Smoke. In addition, a separate subgoal related to reporting was abstracted out of the original analyses.

Table 1

Summary of Major Crew-Level Subgoals

Number	Title
1.	Prepare Tank
2.	Acquire Target(s)
3.	Issue Fire Command
4.	Engage Single Main Gun Target Using Precision Gunnery
5.	Engage Single Coax Target Using Precision Gunnery
6.	Engage Single Target Under Degraded Conditions
7.	Engage Target from TC Position
8.	Engage Target from Loader's Station
9.	Engage Multiple Targets
10.	Adjust Direct Fire
11.	Take Immediate Action
12.	Employ Smoke
13.	Report

The reader may note in Table 1 that whereas single engagements are differentiated with respect to certain conditions (e.g., single main gun targets vs. single machine gun engagements), multiple targets are not so differentiated. Following Hoffman and Morrison's rationale, the single target engagements (subgoals 4-8) were regarded as prototypical in that they require most of the subtasks that are performed under more complex (e.g., degraded, multiple target) conditions. Separate subgoals were defined for single-target engagements for the main gun, coax engagements, and degraded engagements to ensure that all the basic engagement subtasks were identified. Then the multiple target subgoal was used to identify only those subtasks that were peculiar to multiple-target engagements. Given this limited definition, it was unnecessary to define separate multiple-target subgoals for differing conditions. This schema was designed to identify the different subtasks that crews perform, but not necessarily all the conditions under which subtasks are performed thereby eliminating the redundancy of previous analyses. For instance, the subtask related to lasing to a target is not differentiated on the basis of single target vs. multiple target conditions.

Each subgoal was then examined to reveal appropriate subtasks required to accomplish the subgoal. The resulting subtasks were subdivided as necessary creating a hierarchic organization typical of structured task analysis. At the same time, task data were taken from previous analyses of gunnery (Morrison & Hoffman, 1988; Meade, 1989), which provided a detailed specification of tactical gunnery behaviors. Individual behaviors under each major subgoal were then grouped into subtasks. The lists of subtasks from the top-down and bottom-up analyses were reconciled as necessary to provide a single list. To validate the subtasks and to aid in reconciling differences between the two analyses, a list of defining characteristics of tasks (or subtasks) was compiled from the literature. These characteristics were used to generate the following five criteria for distinguishing between subtasks and/or determining whether or not a group of behaviors constitute a subtask:

1. A subtask consists of a set of interrelated behaviors that occur closely in time to accomplish an identifiable task goal or subgoal. The title of the subtask should, in turn, reflect this goal.

2. Subtasks are normally differentiated on the basis of the person (i.e., crewmember) performing the task. Exceptions to this rule were subtasks that require the coordinated effort of two crewmembers, e.g., "Employ Multiple Return Strategies" and "Engage Simultaneous Targets." If such coordination is required, tasks should not be subdivided into separate subtasks for each crewmember.

3. Subtasks are differentiated on the basis of stimuli that control performance. Two types of stimuli can be identified: First are the initiating stimuli that cue performance; these correspond to the "conditions" portion of a task statement. For instance, the tank commander's fire command provides the initiating stimulus for many of the target engagement subtasks. Second are stimuli or stimulus dimensions that affect the difficulty of subtask performance or the required behaviors; these stimuli are "independent variables" in the sense that they control subtask performance. Target range

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and movement are examples of difficulty factors for target engagement subtasks.

    4. Each subtask must be associated with at least one of the following three types of performance measures: speed, accuracy, and outcome. Each subtask should have at least one of these types of performance measures associated with each.

    5. Tasks can be distinguished by the internal information processes (i.e., skills) that are required of the performer. A number of information processing taxonomies have been developed with elaborate categories. Review of categories indicated that they may be reduced to a limited number of categories (see Table 2) and still capture important between-task differences.

    The subtasks were laid out in spreadsheet fashion listing each of these criteria per subtask. The process of listing the criteria guided the process of grouping and subdividing tasks. The analysts started by identifying subgoals within the subtask. If the subgoals were differentiated on the basis of any of the criteria, a corresponding subtask was created. The analysts noted that there was a tendency to excessively subdivide subtasks. They countered this tendency by the following guidance: A subtask should include enough substance to stand on its own as a meaningful training objective. However, if there were legitimate arguments for subdividing or not subdividing, the analysts opted for subdividing because having too many subtasks was a less serious error than having too few.

    To determine the adequacy of domain coverage, the list of subtasks was compared with tasks in the M1 Operator's Manual (TM 9-2350-255-10), task lists in a recent research publication (Quinkert, 1987), and with doctrinal lists of armor tasks. The doctrinal lists included the Master Task List for Career Management Field 19 and a draft of the Crew Tasks List, both prepared by the Directorate of Training and Doctrine. The present analysis covered all content areas in these documents. The only inadequacy noted was a lack of detail in misfire procedures. The subtasks under this subgoal were elaborated accordingly.

Development of Binary Descriptors

    To cluster subtasks, each was coded with respect to a set of binary descriptors as shown in Table 2. These descriptors were chosen to represent dimensions of similarity with respect to training design and development. For instance, Boldovici et al. (1977) suggested that subtasks that are highly time constrained should be trained together. In addition to this performance requirement, three other categories of descriptors were used to describe the similarity of objectives on the basis of (a) their fidelity requirements, (b) their functional relation to the whole task, and (c) their information processing/responding requirements. The rationale for each of these categories is described in the following paragraphs.

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Table 2

Subtask Descriptors

DESCRIPTOR CATEGORY

Rating Instructions

     Individual Descriptors

CREW MEMBER PERFORMING

Indicate crewmember performing the task. More than one crewmember may be indicated.

1. TC
2. GNR
3. LDR
4. DVR

FIDELITY REQUIREMENTS: INTERIOR OR APPENDED FUNCTIONAL COMPONENTS

Indicate which of the following types of functional components serve as either initiating or controlling stimuli during subtask performance

5. Continuous controls
6. Frequently used switches/rheostats
7. "Set & forget" switches/rheostats
8. Indicators
9. Sights (including periscopes)
10. Weapons
11. Ammunition

FIDELITY REQUIREMENTS: EXTRA-TANK VISUAL SCENES

Indicate which of the following visual scenes are <u>required</u> for subtask performance.

12. Varied targets
13. Varied terrain
14. Target movement
15. Owntank movement
16. Multiple targets
17. Thermal imagery

FIDELITY REQUIREMENTS: MOVEMENT

Indicate which of the following systems are moving during subtask performance or as a result of performance.

18. Platform
19. Turret (azimuth)/main gun (elevation)
20. Main gun recoil

FIDELITY REQUIREMENTS: SYSTEM FAILURES

Indicate which of the following system failures are initiating conditions for subtask performance.

21. Rangefinder
22. Turret power
23. Stabilization
24. Weapon system

<div align="right"><u>(table continues)</u></div>

DESCRIPTOR CATEGORY

Rating Instructions

    Individual Descriptors

GUNNERY SUBGOALS

Indicate which of the following gunnery "subgoals" the subtask addresses. An individual subtask may address more than one subgoal.

    25. Prepare tank
    26. Acquire target(s)
    27. Engage target(s)
    28. Maneuver tank
    29. Communicate externally
    30. Assess results/sustain

INFORMATION PROCESSING REQUIREMENTS

Indicate which of the list of types of information processing demands are most typical of the subtask. A task may involve more than one type, but identify the one, or perhaps two, categories that most typify the subtask.

    31. Perception (Detection, Recognition, Classification)
    32. Cognition (Problem Solving/Decision Making/Rule Using)
    33. Recall of discrete responses (Procedures)
    34. Perceptualmotor control
    35. Gross motor control
    36. Oral communication (sending or receiving)
    37. Written (text) information

RESPONSE REQUIREMENTS

Indicate which of the following overt response groups are involved in subtask performance.

    38. Finger manipulation
    39. Hand-arm movement
    40. Foot-leg movement
    41. Head-shoulder movement

TASK AUTOMATION

Indicate whether or not the subtask speed is an inherent aspect of subtask performance.

    42. Requires speeded response

        Fidelity requirements. Tasks within clusters should be similar in their fidelity requirements so that they might be assigned to a single training device or medium, if appropriate. Four dimensions of fidelity were considered: (a) interior or tank-appended components, (b) exterior visual scene, (c) movement, and (d) system failures. As can be seen in Table 2, each of these dimensions of fidelity were described by a set of related descriptors. Note that the fidelity descriptors were descriptive of tanks in general, not the M1 or M1A1 in particular.

Functional subgoals. Subtasks within clusters should also be functionally related. Boldovici et al. (1977) noted occasional quirks in their results brought about by the clustering of functionally dissimilar subtasks. The solution to this problem is to include descriptors that indicate the subgoal(s) that an individual subtask addresses. The 13 subgoals displayed in Table 1 were considered too elaborate for these purposes. They were reduced to 6 as follows: (a) prepare tank, (b) acquire target(s), (c) engage target(s), (d) maneuver tank, (e) communicate externally, and (f) assess results/sustain.

Skill category. Subtask clusters should be similar with respect to skill category. Gagné (1972) argued that tasks may be classified with respect to a limited number of skill categories, and that each category had its own learning requirements. Braby, Henry, Parrish, and Swope (1975) took this reasoning one step further and developed unique training strategies for each of the skill types. Boldovici et al. (1977) reasoned that if tasks similar in underlying skills were trained together, economies in training could be realized. Skills can be classified at both the covert, information processing level and the overt, response system level. With respect to information processing requirements, Fleishman and Quaintance (1984) reviewed a variety of task taxonomies based on information processing (e.g., Berliner, Angell, & Shearer, 1964; Levine & Teichner, 1973; Miller, 1973). Five information processing categories of types of tasks appeared common to these schemes: (a) perceptual, (b) cognitive, (c) procedural, (d) perceptualmotor, and (e) gross motor control tasks. To these categories were added two additional information processing requirements (oral and written communication) that tap different input/output information processing resources in multiple resource theory (e.g., Wickens, 1989). With regard to overt response groups, four systems identified by Boldovici et al. were used: (a) finger manipulation, (b) hand-arm movement, (c) foot-leg movement, and (d) head-shoulder movement.

Boldovici et al. (1977) argued that the number of descriptors should strike a balance between being comprehensive in including most similarity factors, yet be manageable to the analysts. The resulting set of 42 binary (yes/no) descriptors, presented in Table 2, met both criteria. Note also that Table 2 provides a short statement that summarizes the rating instructions.

Cluster Analysis Procedures

Several types of cluster analysis and linkage techniques could have been applied to the binary descriptor data. A problem common to most of these techniques is that cluster boundaries are difficult to identify from the typical tree diagrams. An exception is the k-means method of cluster analysis. This method splits a set of data into k mutually exclusive, not necessarily hierarchical, clusters by maximizing the between-cluster variance with respect to the within-cluster variance. Wilkinson (1988) described the k-means solution as follows: "In rough terms, it is like doing a one-way analysis of variance where the groups are unknown and the largest F-value is sought by reassigning members to each group" (p. 375). The k-means analysis also provides significance tests for each descriptor to determine which differentiate the clusters. At the beginning of a k-means analysis, the

number of clusters was specified. Multiple runs of the data were performed systematically varying this parameter. In general, the number of significant descriptors increased up to a point and then decreased as the number of clusters was increased. Also, as Wilkinson noted, unnecessary increases in this parameter introduces more noise than information about the data. To attempt to maximize information, the "best" solution was defined as that having the greatest number of significant descriptors. In some of the cases, however, there were ties among solutions in the number of significant descriptors. In that case, the simplest solution (i.e., that requiring the lowest number of clusters) was preferred.

Results and Discussion

The crew-level subtasks are listed under subgoals 1-13 in Appendix A along with the criteria that were used to differentiate them. To prevent overlap, subtasks were defined at the lowest subdivision of task subgoals. That is, if a subtask was divided into two subtasks, the two subordinate subtasks were counted but not the superordinate task from which they were derived. Using this rule, a total of 92 crew-level subtasks were identified in Appendix A. Note that if "crewmember performing" is not listed for a particular subtask, it is understood to be the same as its superordinate subtask. Subtasks associated with the first gunnery subgoal (Prepare Tank) were judged as only tangentially relevant to the threat scenarios. Thus, subtasks in the "Prepare" subgoal are not considered further in subsequent analyses. Table 3 provides a breakdown of the number of subtasks identified in Appendix A by crew position.

Table 3

Numbers of Subtasks by Crewmember Performing[a]

| | Number of Subtasks Performed by | | | |
	Commander	Gunner	Loader	Driver
Including "Prepare" Subtasks	45	37	22	12
Not Including "Prepare" Subtasks	38	25	11	7

[a]The total number of subtasks is less than the sum of subtasks by crewmember because some subtasks require more than one crewmember to perform.

With regard to the spreadsheet entries in Appendix A, it should be noted that they were intended to be representative of the criteria, not an exhaustive description of each. For instance, the "difficulty factors" provide but a partial listing of representative variables that control performance. It should also be noted that the table does not specify the particular behaviors involved in each subtask. This would have needlessly complicated the purpose of the spread sheet, which was to describe the extent of the domain of gunnery training objectives. In other words, some descriptive detail was sacrificed for the sake of comprehensiveness.

Following the practice of Boldovici et al. (1977), cluster analyses were performed for each crew position separately as opposed to clustering across all four duty positions. Appendix B presents the detailed results of the analysis by sorting subtasks into the groups resulting from the k-means cluster analyses and indicating which of the 42 descriptors significantly differentiated the groups. Table 4 summarizes the results of the analyses by illustrating how the clusters differ with respect to the significant descriptors. Note that results from the driver analysis are not presented in this table. Whereas the results in Appendix Table B-4 shows a two-cluster solution for the driver analyses, none of the descriptors significantly differentiated the clusters. This was probably due to two reasons: There were only seven subtasks assigned to the driver, and the tasks were relatively homogeneous. For these reasons, the driver subtasks were regarded as constituting a single cluster.

The results from the analyses were interpreted as identifying eight unique categories of gunnery subtasks, which are summarized in Table 5. This interpretation was based on the similarities and differences among the three remaining cluster solutions (i.e., tank commander, gunner, and loader). One evident similarity is that, for all three analyses, most of the subtasks were grouped into the first cluster. In the gunner analyses, these subtasks included the continuous control procedures related to manipulation of control handles in both machine gun and main gun engagements. Most of the subtasks in this cluster were psychomotor subtasks requiring high fidelity representation of internal tank controls and external visual scenes. Results from the loader analysis evidenced a similar cluster of manipulation subtasks related to loader machine gun engagements. However, the loader cluster also included subtasks related to loading the weapons which does not require the simulation of external visual scenes. The tank commander cluster contained the subtasks related to the manipulation of control handles as well as other, more cognitive subtasks related to controlling the engagement. The latter type of subtask appeared to be sufficiently different from the former category titled "Manipulation of Gun Controls" to warrant a separate category that was named "Engagement Control Procedures."

Subtasks related to target acquisition were clustered together as a separate group for the tank commander (Cluster Number 5) and for the loader (Cluster Number 2). The following similarities were observed between and within these two clusters: (a) they require the simulation of the sights and external visuals, (b) they require perceptual skills, and (c) they involve head-shoulder movement, but (d) they are not speeded responses. Although the target acquisition subtasks formed separate clusters for the tank commander

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Table 4

Summary of Results from Cluster Analyses of Tank Commander, Gunner, and Loader Subtask Data

| | Clusters | | | | | | | | | | |
| | Tank Commander | | | | | Gunner | | | | Loader | |
	1	2	3	4	5	1	2	3	4	1	2
Number of Subtasks in Cluster	26	1	5	1	5	20	2	2	1	7	4
Descriptors[a]											
5. Continuous controls	-	-	-	-	-	1	0	1	0	-	-
8. Indicators	0	0	0	1	0	0	0	0	0	-	-
9. Sights	1	1	0	0	1	-	-	-	-	0	1
11. Ammunition	-	-	-	-	-	0	0	0	0	1	0
12. Varied targets	1	1	0	1	1	-	-	-	-	-	-
13. Varied terrain	1	0	0	1	1	1	0	0	1	0	1
14. Target movement	-	-	-	-	-	1	0	0	1	0	1
15. Owntank movement	1	0	0	1	1	1	0	0	1	0	1
16. Multiple targets	-	-	-	-	-	1	0	0	1	0	1
17. Thermal imagery	-	-	-	-	-	1	0	0	1	0	0
21. Rangefinder	0	0	0	1	0	0	0	0	1	-	-
22. Turret power	0	0	0	1	0	0	0	0	1	-	-
23. Stabilization	0	0	0	1	0	0	0	0	1	-	-
24. Weapon system	0	1	0	0	0	0	0	1	0	-	-
26. Acquire target(s)	-	-	-	-	-	-	-	-	-	0	1
27. Engage target(s)	1	1	0	1	0	-	-	-	-	-	-
28. Maneuver tank	0	0	0	0	0	-	-	-	-	-	-
30. Assess results/sustain	0	1	0	0	0	0	0	1	0	-	-
31. Perception	0	0	0	0	1	-	-	-	-	0	1
33. Recall of discrete responses	0	1	0	1	0	0	1	1	1	-	-
34. Perceptualmotor control	-	-	-	-	-	1	0	0	0	-	-
35. Gross motor control	-	-	-	-	-	0	0	1	0	-	-
41. Head-shoulder movement	0	0	0	0	1	0	0	0	1	0	1
42. Requires speeded response	1	1	1	1	0	-	-	-	-	1	0

[a]One (1) indicates the presence of the descriptor characteristic in more than 50% of the subtasks in the cluster, whereas zero (0) indicates its presence of the characteristic in 50% or fewer of the subtasks in the cluster. Blank (-) indicates that the descriptor was not significant ($p > .05$) for the analysis.

Table 5

Categories of Subtasks with Reference to Cluster Analysis Results

Subtask Category	References to Cluster Analysis
Representative subgoals/tasks	

Manipulation of Gun Controls
    Track target
    Apply lead to moving target
    Acquire target (gunner)
	Tank Commander Cluster #1
	Gunner Cluster #1
	Loader Cluster #1

Tank Commander Engagement Control
Procedures
    Adjust fire
    Control tank movements
    Employ smoke
	Tank Commander Clusters #1, #3

Target Acquisition Acquire target (TC, loader)	Tank Commander Cluster #5, Loader Cluster #2

Immediate Action
    Fail-to-fire procedures
    React to runaway coax
	Tank Commander Cluster #2
	Gunner Cluster #3

Switch Setting Procedures
    Set FCS switches
    Index range through CCP
	Tank Commander Cluster #3
	Gunner Cluster #2

Fire Commands/Report
    Issue fire command
    Announce subsequent fire command
    Report
	Tank Commander Cluster #3

Degraded Modes
    Choose degraded mode technique
    Choose appropriate sight
	Tank Commander Cluster #4
	Gunner Cluster #4

Maneuver Tank
    Drive tactically
    Search--closed hatch
	All Driver subtasks

and gunner analyses, analogous target acquisition subtasks for the gunner were included in the large cluster entitled "Manipulation of Gun Controls." The reason for this apparent inconsistency was that the gunner acquires targets through his gun sights. In order to obtain an adequate field of view, he must rotate the turret using his control handles in much the same way that he tracks targets. Thus, acquiring targets is similar to target engagement for that duty position.

Two similar clusters of subtasks relating to failure-to-fire procedures were noted in the tank commander (Cluster Number 2) and gunner analyses (Cluster Number 3). The subtasks in this cluster entitled "Immediate Action" were similar in the following respects: (a) they involved the recall of discrete procedures, (b) they required the simulation of the weapon system, but (c) they did not require elaborate extra-tank visuals. Although the loader performs immediate action type tasks, a similar Immediate Action cluster was not apparent in the loader analysis. This was probably due to the fact that only two loader subtasks required extra-tank visuals thereby reducing the distinction between immediate action and other tasks. Also, the number of loader tasks (11) is quite limited, which in itself makes it more difficult to support an elaborate cluster structure.

Two other similar clusters pertaining to switch setting were observed in the results from the tank commander (Cluster Number 3) and gunner (Cluster Number 2). Subtasks in these clusters had the following commonalities: (a) they do not require continuous controls or sights, (b) they require little in the way of extra-tank visuals, and (c) they are procedural in nature. However, note that the tank commander cluster includes three subtasks that do not involve switch setting: (a) "Announce Subsequent Fire Command" (Subtask 10.2), (b) "Direct Tank Movements" (Subtask 4.2.1), and (c) "Provide Spot Report" (Subtask 13.1). All three are similar to the others in terms of the criteria described above, but actually pertain more to oral communication than to the setting of switches. Inclusion of these latter three subtasks in this switchology cluster should probably be regarded as an anomaly of the descriptor scheme rather than an indication that these subtasks should be trained together with switch setting. To reconcile these problems, these oral tank commander subtasks were moved to categories to which they were more clearly related: The two subtasks related to subsequent fire command and to spot reporting were moved to the fire command category (renamed "Fire Command/Report"), and the subtask related to directing tank movements was moved to the category named "TC Engagement Control Procedures."

Two single-subtask clusters in both the tank commander and gunner analyses were distinguished from the other clusters. The tank commander cluster included the subtask entitled "Choose Degraded Mode Technique," whereas the gunner cluster contained the subtask entitled "Choose Appropriate Sight." These clusters were titled "Degraded Modes" because both required cognitive processing (decision making/rule using) related to compensating for degraded functioning of the sights or fire control system. In addition to being cognitive in nature, both subtasks were different from the others on the basis of their requirement to simulate system failures.

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Finally, the driver subtasks failed to reveal significant descriptors suggesting that the subtasks were a homogeneous cluster. Examination of the task data indicates that, indeed, there were several similarities among driver subtasks. For instance, most of the driver subtasks required the simulation of visual sights and external visual scenes, required perceptual skill, and involved some form of oral communication. In short, the driver subtasks were regarded as a separate cluster.

In general, the clusters were not as differentiated as those derived by Boldovici et al. (1977). One reason for the difference may simply have been the use of different clustering techniques. Boldovici et al. used an amalgamative procedure that constructed the clusters from the bottom (individual tasks). Consequently, their structure was more ornate. Another reason why the present clusters were less differentiated was that the present domain was restricted to gunnery related tasks, whereas Boldovici et al. examined all operational tasks. Despite these differences, both applications of the cluster analysis techniques were similar in that they provided interpretable information that is potentially useful for training design.

Chapter 3

Platoon Level Objectives

Platoon level gunnery builds and elaborates on the basics of the individual and crew level tasks identified in the previous chapter. The platoon objectives were defined in terms of two types of subtasks: platoon collective subtasks and platoon leadership subtasks.

Analytic Method

Although, in many situations, it is often impossible to separate an individual leadership task from the collective task it initiates and controls, the approach used was to treat the two types as distinct categories for purposes of our analysis. Derivation of both sets of tasks is described in the following two sections.

Platoon Collective Subtasks

To insure adequate coverage of the domain of collective subtasks, and to still restrict that domain to those subtasks that were directly related to gunnery performance, two separate methods were employed to generate prospective collective tasks. One method involved using a "bottom-up" approach in which existing doctrinal sources (ARTEP 17-37-10-MTP, The Armor Collective Front End Analysis [CFEA], FC 17-15, FM 17-12-1) were surveyed and selective choices were made of those tasks that supported gunnery and related areas. The other approach employed a "top-down" analysis in which the broad tactical functions of movement, position, firepower, and coordination were first identified, then supported by gunnery specific tasks appropriate for platoon level employment.

The first (bottom-up) method produced a candidate list of 14 subtasks, while the second (top-down) approach proposed 23 subtasks. (Both original lists are shown in Appendix C.) After the two lists were prepared independently, they were compared. While there was considerable congruence between the lists, few tasks were exactly duplicated. To arrive at a single list, four steps were taken:

1. Subtasks that were alike, or conveyed essentially the same activity, on both lists were combined and adopted.

2. Subtasks that were distinct (i.e., appeared on one list but not the other) were adopted.

3. Because communications, security, and decision making are an inherent component in all armor collective tasks, any specific requirement for any of those three functions was dropped as a separate subtask.

4. The combined and remaining subtasks were restructured and reworded for clarity and consistency.

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Platoon Leadership Subtasks

The specification of the platoon collective subtasks served as the basis for the identification of the platoon leadership subtasks. Leadership subtasks were specified primarily when needed to initiate or control platoon movement and platoon fires. Because communicating externally is an essential individual requirement of collective tasks (and clearly leadership oriented), reporting was added to the primary leadership functions of movement and firepower. Although not specifically aligned with movement, firepower, or reporting, a fourth area--requesting indirect fire--was found to overlap all three and so was added as an independent function. The tentative areas of focus were checked against doctrinal task requirements in the Skill Level 4 Soldier's Manual (19K) and the Military Qualification Standards (MQS) II for Armor Lieutenants, for compatibility and completeness.

Results and Discussion

Table 6 presents the list of 19 platoon collective subtasks. Many of the performance requirements of the collective subtasks are described by the individual subtasks identified earlier. Stripped of their individual task components, collective tasks become exercises in interactive and coordinative skills, focusing on the specific eight functional areas identified in the table. Thus, the previous criteria for distinguishing individual and crew-level tasks were judged to be inappropriate for the collective tasks. Similarly, the cluster analyses were not performed because the individual subtask descriptors were inappropriate, and because there were too few collective subtasks.

The platoon leadership subtasks were incorporated with the other individual and crew tasks in Subgoals 13, 14, 15, and 16 of Appendix A. (The reporting requirement was added to a similar but internal requirement for the tank commander in Subgoal 13; the other areas were added as Subgoals 14, 15, and 16). A total of seven unique platoon leadership subtasks were added to the analysis. These subtasks were not clustered because they were few in number and they were homogeneous; i.e., they are cognitive/verbal tasks that are not dependent on a representation of tank components.

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Table 6

Platoon Collective Subtasks

1. Travel in Platoon Formation
   1.1. Execute a Wedge Formation
   1.2. Execute an Echelon Formation
   1.3. Execute a Line Formation
   1.4. Execute a Vee Formation
   1.5. Execute a Column or Staggered Column

2. Execute Battle Drills
   2.1. Execute Action Drill
   2.2. Execute Contact Drill
   2.3. Execute Air Attack Drill

3. Bound by Section

4. Overwatch a Bounding Platoon

5. Occupy a Battle Position
   5.1. Occupy Initial Battle Position
   5.2. Occupy Subsequent Battle Position

6. Maneuver within a Battle Position

7. Employ Fire Patterns
   7.1. Employ Frontal Fire
   7.2. Employ Cross Fire
   7.3. Employ Depth Fire

8. Employ Firing Techniques
   8.1. Employ Observed Fire
   8.2. Employ Alternating Fires
   8.3. Employ Simultaneous Fires

Chapter 4

Relationship of Objectives to Threat Scenarios

In the previous sections, the crew- and platoon-level training objectives were identified as a collection of individual and crew subtasks. This final section provides an analysis indicating which of the previously derived threat scenarios could support training or performance testing of these objectives. The fundamental purpose of this analysis was to examine the relationship between the objectives and the threat scenario conditions. This analysis also serves as input data to parallel research on the development of an algorithm for selecting threat engagement scenarios for training and testing (C. Campbell & Hoffman, 1989). The selection algorithm is designed as a research tool for supporting the development of realistic conditions for training and testing.

Analytic Method

The threat-based scenarios are summarized briefly in Table 7. As can be seen there are 42 different scenarios differing in the range and mix of threat targets. In addition to these scenarios, seven enhancements were developed to meet particular training needs. These enhancements were designed such that they can be overlaid on (almost) any scenario, yet they are not essential to the portrayal of any scenario. The following is a list of these enhancements identified by letter:

A. Tactical Combat Air Support
B. Attack Helicopter
C. Electronic Warfare
D. Chemical Warfare
E. Obstacles/Barriers/Countermobility
F. Indirect Fire: Cannon/Mortar/Rocket
G. Smoke/Obscuration

Originally, the method called for analysts to make yes/no judgments as to whether or not an objective could be trained or tested within each of the scenarios. It became obvious that a three-alternative judgment was more appropriate: (a) that the objective could be trained or tested within the scenario as presently stated, (b) that the objective could not realistically be trained or tested within the scenario, and (c) that the objective could be trained or tested within the scenario only if certain additional conditions were added to the scenario. It was further determined that if an objective were judged in the third category, the extra-scenario conditions should be made explicit for the purpose of future training and test development.

Table 7
Summary of Threat Scenarios

Red/Blue Mission

Scenario Number	Range	Attrition Rate	Threat Targets[a]					
			T-80	BMP-2	2S1	BMP-M1974	BTR-50PK	IMR-2
Attack/Defend								
1.0	3000	None	12	28				
1.1	2000	High	10	23				
1.2	1000	High	8	17				
1.3	400	High	7	13				
1.4	2000	Low	10	27				
1.5	1000	Low	9	25				
1.6	400	Low	8	24				
Meeting Engagement/Defend								
2.0	3000	None	4	9	6	2		
2.1	2000	High	3	6	6	2		
2.2	1000	High	3	5	4	1		
2.3	400	High	2	3	4	1		
2.4	2000	Low	3	9	6	2		
2.5	1000	Low	3	9	5	1		
2.6	400	Low	2	9	5	1		
Meeting Engagement/Attack								
3.0	3000	None	4	12				
3.1	2000	High	3	10				
3.2	1000	High	2	8				
3.3	400	High	2	6				
3.4	2000	Low	3	12				
3.5	1000	Low	3	11				
3.6	400	Low	3	10				
Defense/Attack								
4.0	3000	None	4	12				
4.1	2000	High	4	10				
4.2	1000	High	2	8				
4.3	400	High	2	6				
4.4	2000	Low	4	11				
4.5	1000	Low	4	10				
4.6	400	Low	3	10				
Withdrawal/Attack								
5.0	3000	None	1	4				
5.1	2000	High	1	3				
5.2	1000	High	1	2				
5.3	400	High	1	1				
5.4	2000	Low	1	4				
5.5	1000	Low	1	4				
5.6	400	Low	1	3				
Breakthrough/Defense								
6.0	0	None	10	3			1	1
6.1	400	High	9	2			1	1
6.2	1000	High	7	2			1	1
6.3	2000	High	3	2			1	1
6.4	400	Low	10	3			1	1
6.5	1000	Low	9	3			1	1
6.6	2000	Low	8	2			1	1

[a]T-80 = Main Battle Tank, BMP-2 = Armored Infantry Combat Vehicle, 2S1 = 122mm Howitzer (self-propelled), BMP-M1974 = Artillery Command/Control Vehicle, BTR-50PK = Mine Clearer, IMR-2 = Armored Engineer Tractor.

Results and Discussion

The detailed results from the judgments of whether subtasks can be trained in these scenarios are presented in Appendix D; individual and crew subtasks (including platoon leadership) are presented in Table D-1, and the platoon collective subtasks are presented in Table D-2. In those tables, the subtasks that can be trained/tested in a scenario were coded as a "2," and those that cannot be trained/tested were coded as a "0." The third category of judgments, where the subtask can be trained/tested only with the specification of additional conditions, were coded as a "1." With regard to the third category, the additional conditions are elaborated upon in the comments that are attached to the tables. In some cases, the extra-scenario conditions could be fulfilled by a scenario enhancement. If so, the enhancement was identified by letter.

Examination of the tables in Appendix D indicated that most scenarios could support training on a wide variety of subtasks. Exceptions to this generalization were the initial scenarios for the first five groups of mission combinations (i.e., 1.0, 2.0, 3.0, 4.0, and 5.0). The common feature of these scenarios was that the threat targets were all at an extended range (3000 meters). Many of the crew and platoon subtasks were irrelevant to these scenarios simply because the targets were out of range of direct fire weapons.

Closer examination revealed that the subtasks could be sorted into three categories according to the pattern of scenarios with which they were associated. The largest category were subtasks that could be trained in all scenarios, except for the aforementioned initial scenarios. Of the 90 total subtasks, 49 (or 54%) fell into this category. For instance, the crew-level subtask entitled "Use Cover and Concealment" (Subtask 4.2.4) was applicable to all threat engagement scenarios. Similarly, the platoon-level subtask entitled "Employ Simultaneous Fires" (Subtask 8.3) was applicable to all scenarios except those where targets are out of direct-fire range (i.e., where range = 3000). This category also included subtasks that could be trained in all or most scenarios, but only under special conditions (i.e., they were classified as "1" subtasks). An example of this type of crew-level subtask was "Use Manual Controls" (Subtask 6.1.5). As noted in the Appendix, the special conditions required for this subtask to occur was the loss of either turret power or some specific electrical or hydraulic power failure. Another example of a platoon-level subtask falling in this category was "Execute Air Attack Drill" (Subtask 2.3). The special condition for this subtask was an air attack, which was not called for in any of the threat engagement scenarios. However, this subtask was appropriate given the employment of either one of two scenario enhancements: Enhancement A (Combat Air Support) or Enhancement B (Attack Helicopter).

A second category included subtasks that could be trained in some but not other scenarios. This category accounted for 38 subtasks or approximately 42% of the total. An example crew-level subtask in this category was "Maintain Steady Platform" (Subtask 4.2.3), which was a driver subtask relevant to moving engagements. Because this subtask related to firing on the move, it was associated with offensive scenarios only. On the other hand, the platoon-level subtask entitled "Occupy Battle Position" (Subtask 5.0)

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described actions related to taking a static battle position. Therefore, it was appropriate for defensive scenarios only.

The third and smallest category consisted of only three crew-level subtasks (3% of the total) that were not associated with any of the scenarios. These crew-level subtasks were (a) "Range to Target Using TC's Weapon" (Subtask 2.3.2), (b) "Mark Target Using TC's Weapon" (Subtask 3.1.3.2), and (c) "Engage Point Target(s) with Loader's M240 Machine Gun" (Subtask 8.1). With regard to the first two subtasks involving the tank commander's weapon, these subtasks represent the last in a series of options for either ranging or specifying direction. To make this option appropriate would require a highly contrived situation, which would detract from the point of the scenario. The last loader subtask was not relevant to the scenarios for two reasons: (a) the open sights on the loader's machine gun do not allow a precise lay on a point target; and (b) it is more likely that the loader's task would be to provide suppressive fire, which would normally involve area engagement. For these reasons, the three subtasks were not judged relevant to the threat scenarios.

Further examination of the crossindexing of subtasks and scenarios revealed an important difference between the individual/crew subtasks (i.e., crew-level and platoon leadership subtasks) and platoon collective subtasks. Table 8 shows that whereas a majority of crew-level subtasks could be trained in all except the initial scenarios, a majority of platoon-level subtasks were associated with some but not other scenarios. The differences between the results from the individual/crew and collective analyses may be explained by examining the sorts of conditions that affect performance. In general, the applicability of platoon collective subtasks was determined by threat-based conditions such as range to target, force ratio, and Blue mission. These conditions affect performance largely by determining whether the platoon assumes either an offensive or defensive posture. In contrast, these conditions had less of an effect on individual and crew subtasks. For instance, target engagement and tactical maneuver subtasks at the individual and crew level apply equally to offensive and defensive missions.

Inspection of the "additional" conditions attached to Table D-1 indicate that in contrast to platoon collective subtasks, individual and crew subtasks are affected by hardware conditions, i.e., those related to Blue vehicle and weapon systems. Hardware conditions affected the applicability of individual and crew subtasks in three ways. First, the vulnerability of Red (threat) targets to Blue (friendly) weapons affected the weapon selection process. Second, the lethality of Red targets affected blue tactics in both maneuver and in target priority judgments. This conclusion was not readily apparent from the present analysis because threat arrays within the scenarios consisted of a mix of Red systems. Third, Blue hardware status conditions affected choice of subtask primarily through the specification of degraded conditions.

Table 8

Frequency and Percent of Subtasks That Could Be Trained in All, Some, or None of the Threat Engagement Scenarios

Type of Subtask		Number of Threat Engagement Scenarios		
		All[a]	Some	None
Individual/Crew[b]	f	43	25	3
	(%)	(61%)	(35%)	(4%)
Platoon Collective	f	6	13	0
	(%)	(32%)	(68%)	(0%)

[a]Does not include initial scenarios (i.e., 1.0, 2.0, 3.0, 4.0, 5.0)
[b]Includes individual and platoon leadership subtasks.

Two general implications were derived from these analyses. First, the results from the analyses indicated that the threat-based conditions have a large effect on determining which platoon collective subtasks can be trained. It is likely that the choice of platoon collective subtasks should be the primary "driver" in selecting a threat-based scenario. Second, blue hardware manipulations must be interjected in the scenarios in order to measure specific individual and crew subtasks.

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Chapter 5

Summary and Conclusions

The purpose of the present report was to develop and apply methods for identifying training objectives for threat engagement scenarios that had been derived in previous research (R. Campbell, & C. Campbell, 1989; Doyle, 1989). Various analyses were performed to address that purpose. The findings may be summarized as follows:

1. Rational methods were used to identify a list of crew- and platoon-level subtasks to serve as those training objectives. Reviewing the results against existing task documentation revealed that the list provided a comprehensive collection of gunnery behaviors.

2. Cluster analyses reduced the numerous crew-level subtasks to eight categories of gunnery subtasks that differ with respect to fidelity requirements, functional subgoal, and skill requirements. These subtask categories were named (a) Manipulation of Gun Controls, (b) Tank Commander Engagement Control Procedures, (c) Target Acquisition, (d) Immediate Action, (e) Switch Setting Procedures, (f) Fire Commands/Reports, (g) Degraded Modes, and (h) Maneuver Tank.

3. Crossindexing of subtasks to threat engagement scenarios in which they might be trained revealed a difference between individual/crew and collective subtasks: Whereas most individual and crew subtasks could be trained in all or nearly all threat engagement scenarios, most collective subtasks were associated with some but not other scenarios. It was concluded that the threat scenario conditions were important drivers for collective subtasks. In contrast, other nonthreat conditions (e.g., hardware conditions) were more important for determining whether individual and crew subtasks could be trained in a threat engagement scenario.

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Appendix A

Analysis of Crew-Level and Platoon Leader Subtasks

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	PERFORMANCE MEASURES		
					SPEED	ACCURACY	OUTCOMES

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	SPEED	ACCURACY	OUTCOMES
1. PREPARE TANK							
1.1. Prepare stations for operation (Subtasks are not sequenced)			CREW				
1.1.1. Power up hull systems	Orders to prepare for combat	Initial state of hull systems	DVR	Procedures	Time to Complete	Percent Correct Steps	Resulting status of hull systems
1.1.2. Start engine	Orders to prepare for combat	Ease of start	DVR	Procedures	Time to start	Percent Correct Steps	Engine running
1.1.3. Operate NBC system (M1: gas particulate, (M1A1: overpressure system)	Orders to prepare for combat	System malfunctions / Remaining filter life	DVR	Procedures		Percent Correct Steps	System operating
1.1.4. Install driver's night vision viewer	Orders to prepare for combat during periods of darkness		DVR	Procedures / Gross motor skills	Time to Complete	Percent Correct Steps	Viewer installed and operating
1.1.5. Operate intercom	Orders to prepare for combat	Initial state of intercom systems / System malfunctions	CREW	Procedures	Time to Complete	Percent Correct Steps	Intercom operating
1.1.6. Power up turret	Orders to prepare for combat	Initial state of TC station	TC	Procedures	Time to Complete	Percent Correct Steps	Turret power ON
1.1.7. Perform hydraulic pressure check	Orders to prepare for combat	Initial state of crew station	GNR	Procedures	Time to Complete	Percent Correct Steps	
1.1.8. Stow 105mm ammunition	Orders to prepare for combat	Initial state of ammo storage	LDR	Gross motor skills / Procedures	Time to complete	% rounds loaded per load plan	All available ammunition stowed in operational
1.1.9. Load M250 smoke grenade launcher	Orders to prepare for combat	Initial state of grenade launcher	LDR	Gross motor skills / Procedures	Time to complete	Percent Correct Steps	All tubes loaded
1.1.10. Install loader's night vision viewer	Orders to prepare for combat during periods of darkness		LDR	Gross motor skills / Procedures	Time to Complete	Percent Correct Steps	Viewer installed and operating
1.1.11. Operate radio	Orders to prepare for combat	Initial radio settings.	LDR	Procedures	Time to Complete	Percent correct switch settings	Radio operational on specified frequency.
1.2. Perform prepare-to-fire checks			CREW				
1.2.1. Perform computer self-test	Orders to prepare for combat	Type/extent of FCS malfunctions	GNR	Procedures / Decision making	Time to Complete	Correct ID of malfunctions	"Compensating" inputs to FCS
1.2.2. Perform computer data check	Orders to prepare for combat	Type/extent of FCS malfunctions / Air pressure and temp estimated or measured?	GNR	Procedures / Decision making	Time to Complete	Correct ID of malfunctions	"Compensating" inputs to FCS
1.2.3. Perform TIS checkout	Orders to prepare for combat	FCS malfunctions	GNR	Procedures / Visual Perception	Time to Complete	Correct ID of malfunctions	TIS operational and malfunctions identified and reported

| SUBTASK | INITIATING CONDITIONS | DIFFICULTY FACTORS | CREW MEMBER | SKILLS | PERFORMANCE MEASURES | | |
					SPEED	ACCURACY	OUTCOMES
1.2.4. Update MRS	Orders to prepare for combat	Change in environmental conditions since last MRS update	GNR	Procedures	Time to Complete	Percent correct steps	MRS aligned
1.2.5. Check replenisher			LDR,GNR				
1.2.5.1. Raise/lower main gun	Requirement to check/ fill/drain replenisher		GNR	Fine motor skills	Time to complete	Deviation from req'd elevation	Gun elevation
1.2.5.2. Check replenisher level		Position of tank	LDR	Visual Perception		Correct decision fill/not fill	
1.2.5.3. Fill/drain replenisher	Replenisher fluid level out of tolerance	Amount under minimum/ over maximum operating level	LDR	Procedures	Time to complete	Deviation from ideal fluid level.	Resulting replenisher fluid level
1.3. Boresight Weapons Systems			TC, GNR				
1.3.1. Boresight main gun	New gunner New FCS components	Initial state of gun-sight alignment	TC, GNR	Procedures Visual perception	Time to Complete	Percent Correct Steps	Resulting state of gun-sight alignment
1.3.2. Boresight commander's weapon sight to commander's weapon	Orders to prepare for combat	Initial state of gun-sight alignment	TC	Procedures Visual perception	Time to Complete	Percent Correct Steps	Resulting state of gun-sight alignment
1.4. Prepare Battlecarry Posture							
1.4.1. Announce battlecarry posture/ammo	Imminent threat engagements	Expected threat targets and ranges PLT SOP/Order	TC	Decision making Verbal Communication		Ammo specified corresponds with predominant threat or PLT SOP/order	Battlecarry announcement
1.4.2. Index battlesight range in CCP	Battlecarry announcement		GNR	Procedures Verbal Communication	Time to index	Variation from prescribed range for any/ all types ammo	Battlesight range indexed for each type ammunition
1.4.3. Set FCS switches per battlecarry command	Battlecarry announcement	Prior FCS switch settings	GNR	Procedures	Time to reset switches	Percent switches in correct posns	Resulting switch settings
1.4.4. Load battlecarry ammunition	Battlecarry announcement	Amount battlecary ammo remaining and placement in ready rack	LDR	Gross motor skills	Reload time.	Correct ammo loaded (Y/N), percent ldr's switches in correct posns	Resulting status of ammo & ldr's station
1.4.5. Index battlesight range	Battlecarry ammunition loaded and indexed, or battlesight engagement (GPS/TIS or GPSE) in progress		TC	Procedures	Time to index	Variation from prescribed range for any/ all types ammo.	Battlesight and automatic lead indexed
1.4.6. Load commander's weapon	Orders to prepare for combat	Amount/location remaining ammunition Hatch positions	TC,LDR	Procedures Gross motor	Time to Complete	Percent Correct Steps	Weapon loaded successfully
1.4.7. Load coax	Orders to prepare for combat	Amount/location remaining ammunition	GNR,LDR	Procedures Gross motor	Time to Complete	Percent Correct Steps	Weapon loaded successfully
1.4.8. Load loader's M240	Orders to prepare for combat	Amount/location remaining ammunition Hatch positions	LDR	Procedure Gross motor	Time to Complete	Percent Correct Steps	Weapon loaded successfully

A-2

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	PERFORMANCE MEASURES		
					SPEED	ACCURACY	OUTCOMES
2. ACQUIRE TARGET(S)							
2.1. Search/Detect Target(s)			CREW				
2.1.1. Choose sight for search	Likely threat target(s) in sector	Sight availability/ effectiveness (optics)	GNR	Decision making		Proper sight selection per system/external conditions	GPS/GPSE daylight or GAS selected
2.1.2. Search using daylight sight(s)	Targets anticipated in sector	Range and portion of target exposed; Visibility conditions; MOPP	GNR	Visual perception		False positives/ negatives	Target acquired and identified correctly
2.1.3. Search using thermal sight(s)	Targets anticipated in sector; Reduced visibility conditions	Range and portion of target exposed; Visibility conditions; MOPP	GNR	Visual perception		False positives/ negatives	Target acquired and identified correctly
2.1.4. Search--closed hatch	Targets anticipated in sector; NBC environment/ incoming artillery	Range and portion of target exposed; Visibility conditions	TC LDR DVR	Visual perception	Time to Detect	False positives/ negatives	Target acquired and identified correctly
2.1.5. Search--open hatch	Targets anticipated in sector; Environment permits open hatch operations	Range and portion of target exposed; Visibility conditions; Hatch position(s); Own tank movement	TC LDR DVR	Visual Perception	Time to Detect	False positives/ negatives	Target acquired and identified correctly
2.2. Locate/Recognize Target(s)	Detected target	Range and portion of target exposed; Visibility conditions; Sight availability/ effectiveness (optics); MOPP; Hatch position(s); Own tank movement	CREW	Visual perception; Verbal communication	Time to ID target(s)	Accuracy of target ID; Accuracy of target location	Acquisition report
2.3. Estimate range							
2.3.1. Estimate range visually	Target detection	Visible portion/target; visibility; Accuracy/range sketch	TC	Cognition	Time to calculate	Difference from actual range	Estimated range
2.3.2. Range to target with TC's weapon	Target detection	Visible portion/target; visibility; Actual range	TC	Visual Perception; Psychomotor skills	Time to get Cal .50 on target	Difference from actual range	Estimated range

A-3

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	PERFORMANCE MEASURES		
					SPEED	ACCURACY	OUTCOMES
3. ISSUE FIRE COMMAND							
3.1. Standard fire command			TC				
3.1.1. Issue standard fire command	Acquired target	Type, range, and movement of threat tgt Mission		Decision making Verbal communication	Time from acquisition (report) to fire command	Accuracy of fire command elements	Fire command
3.1.2. Lay main gun for direction	Acquired target	Angle between initial lay and target Hatch positions		Perceptual Psychomotor skill		Angular deviation from gunner's aiming point	Gnr laid on target sights
3.1.3. Specify direction							
3.1.3.1. Specify direction verbally	Acquired target	Commander's power handle inoperative Existence/visibility of reference points Angle between initial lay and target		Visual perception Verbal communication	Time to gunner's acquisition	Content of direction element	Gunner laid on target
3.1.3.2. Mark target with TC's weapon	Acquired target	Commander's power handle inoperative Existence/visibility of reference points Angle between initial lay and target		Visual perception Verbal communication Psychomotor skill	Time to gunner's acquisition	Ang dist. bet. target & weapon effects	Gunner laid on target
3.1.4. Specify range	Estimated range	Target exposure, range Visibility LRF/FCS malfunction		Visual/depth Perception Cognition	Time from acquisition (report) to range element	Error between estimate & actual range	Range element of fire command
3.2. Issue battlesight fire command	Acquired target LRF ineffective	Type, range, and movement of threat tgt Mission	TC	Decision making Verbal communication	Time from acquisition (report) to fire command	Accuracy of fire command elements	Fire command
3.3. Specify multiple target engagement sequence	Acquired multiple targets	No., type, range, movement, and classification of threat targets Mission	TC	Decision making Verbal communication	Time from acquisition (report) to completion of description element	Accuracy of fire command elements Proper sequencing by tgt class. & range	Multiple fire command
3.4. Specify simultaneous engagement	Acquired targets	No., type, range, movement, and classification of threat targets Mission	TC	Decision making Verbal communication	Time from acquisition (report) to completion of description element	Accuracy of fire command elements	Fire command

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	PERFORMANCE MEASURES		
					SPEED	ACCURACY	OUTCOMES
4. ENGAGE SINGLE MAIN GUN TARGET USING PRECISION GUNNERY (NOTE 1)			CREW				
4.1. Fire main gun at target			GNR				
4.1.1. Set FCS switches per fire command	Fire command	Content of fire command		Procedures	Time from FC to switch in pos	Accuracy of switch positions	Resulting switch positions
4.1.2. Identify specified target(s)	Fire command	No., type, range, and movement of threat tgts; Portion of target exposed; Visibility conditions; Sight availability/ effectiveness (optics); Tank movement		Visual perception; Verbal communication	Time from FC to target ID announcement	Confirm correct fire command/ disconfirm incorrect fire command; Correct target selection	Target ID announcement
4.1.3. Track target	Identified target	Apparent target size; Target movement; Visibility conditions; Tank movement		Psychomotor skill		Time on track	Correct angular velocity input to FCS
4.1.4. Lase to target	Maintain track 3 secs	Apparent target size; Target movement; Visibility conditions; Tank movement		Timing; Psychomotor skill	Time from FC to lase	Lay error	Correct range input to FCS
4.1.5. Fire at target	LDR announcement of UP; TC announcement to FIRE	Apparent target size; Target movement; Visibility conditions; Tank movement		Timing; Psychomotor skill	Time from FC to fire	Lay error	Target hit/miss
4.2. Maneuver tank			CREW				
4.2.1. Direct tank movement (issue driving commands)	Plt formation/movement technique	Known/suspected threat; Plt OPORD/FRAGO; Terrain	TC	Decision making; Verbal communication		Correct position in unit formations; Application of movement technique	Driving commands
4.2.2. Clear terrain mask	TC's command: DRIVER - MOVE OUT, GUNNER - TAKE OVER	Engagement in progress; Terrain	GNR	Visual perception; Verbal communication		Tank exposure to threat; Clear line of fire	Driving command: DRIVER - STOP
4.2.3. Maintain platform/ move to defilade/stop smoothly	TC/GNR commands	Terrain	DVR	Psychomotor skill; timing		Vibration; Smoothness of stop	

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| SUBTASK | INITIATING CONDITIONS | DIFFICULTY FACTORS | CREW MEMBER | SKILLS | PERFORMANCE MEASURES | | |
					SPEED	ACCURACY	OUTCOMES
4.2.4. Use cover and concealment	TC commands	Terrain	DVR	Decision making Visual perception Psychomotor skill		Time exposed to threat LOS	
4.3. Load round	Fire command Battlecary announcement	Own tank movement	LDR	Gross motor control Procedures	Time to load	Correct round in chamber	"UP" announcement Ready-to-fire box in GPS/TIS
//							
5. ENGAGE SINGLE COAX TARGET USING PRECISION TECHNIQUE	Fire command		CREW				
5.1. Engage target with coax			GNR				
5.1.1. Engage point target with coax		Apparent target size Target movement Visual conditions Tank movement		Visual perception Psychomotor skill Verbal communication	Opening time	No. of rounds within target area per total rounds fired	Target hit/miss
5.1.2. Engage area target with coax		Apparent target size Target movement Visual conditions Tank movement			Opening Time	Accuracy of initial burst in target area Accuracy of subsequent bursts sweep	Target "effect" (killing burst followed by effective suppression)
5.2. Monitor coax ammo feed			LDR	Procedures			Uninterrupted ammo feed
//							
6. ENGAGE SINGLE TARGET UNDER DEGRADED CONDITIONS			CREW				
6.1. Choose degraded mode technique	Known/suspected FCS malfunctions	Threat situation Visibility conditions	TC	Decision making Verbal communication		Selection/ application of appropriate degraded mode	Target hit/miss
6.1.2. Manually index range			TC,GNR				
6.1.2.1. Index range using manual battle range add/drop toggle	Ineffective LRF	Range, apparent target size	TC	Procedures	Time to index range	Correspondence of estimated (indexed) and actual range	Range indexed into FCS
6.1.2.2. Index range thru computer control panel	TC's command to index range	Range, apparent target size	GNR	Procedures	Time to index range	Correspondence of announced & indexed range	Range indexed into FCS
6.1.3. Choose appropriate sight	Fire command	Visibility conditions	GNR	Decision making		Correct choice of sight	
6.1.4. Apply range in GAS	Range announcement	Apparent target size Target movement Tank movement	GNR	Visual Perception Psychomotor skill		Correct reticle-target relationship	Resulting gun tube elevation

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	PERFORMANCE MEASURES		
					SPEED	ACCURACY	OUTCOMES
6.1.5. Apply lead to moving target	Emergency/manual mode operation	Moving target	GNR	Visual Perception Cognition		Correct reticle-target relationship	Resulting gun tube deflection offset
6.1.6. Use manual control handles/blasting machine	Turret power failure	Apparent target size Target movement Visual conditions Tank movement	GNR	Visual Perception Psychomotor control Gross motor control	Opening time	Lay error	Target hit/miss
6.2. Employ multiple return strategies	Multiple return symbol in LRF		TC,GNR	Decision making Procedures			Correct range indexed in FCS
///							
7. ENGAGE TARGET FROM TC POSITION	GNR is unable to engage target		TC				
7.1. Engage main gun target from TC's position.	Main gun target acquired						
7.1.1. Set FCS switches per fire command	Three-man crew (No gunner)			Procedures	Time from FC to switch in pos	Accuracy of switch positions	Resulting switch positions
7.1.2. Track target		Apparent target size Target movement Visibility conditions Tank movement		Psychomotor skill Visual perception		Time on track	Correct angular velocity input to FCS
7.1.3. Lase to target	Maintain track 3 secs	Apparent target size Target movement Visibility conditions Tank movement		Timing Psychomotor skill Visual perception	Time from FC to lase	Lay error	Correct range input to FCS
7.1.4. Fire at target	LDR announcement of UP TC announcement to FIRE	Apparent target size Target movement Visibility conditions Tank movement		Timing Psychomotor skill Visual perception	Time from FC to fire	Lay error	Target hit/miss
7.2. Engage coax target from TC's position	GNR is unable to engage target Coax target acquired						
7.2.1. Engage point target with coax		Apparent target size Target movement Visual conditions Tank movement		Visual perception Psychomotor skill Verbal communication	Opening time	No. of rounds within target area per total rounds fired	Target hit/miss
7.2.2. Engage area target with coax		Apparent target size Target movement Visual conditions Tank movement			Opening Time	Accuracy of initial burst in target area Accuracy of subsequent bursts sweep	Target "effect" (killing burst followed by effective suppression)

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SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	PERFORMANCE MEASURES		
					SPEED	ACCURACY	OUTCOMES
7.3. Engage target with caliber .50	Cal .50 target acquired						
7.3.1. Apply range in TC's wpn station sight		Apparent target size Target movement Tank movement		Visual Perception Psychomotor skill		Correct reticle-target relationship	Resulting gun tube elevation
7.3.2. Lead moving target		Moving target		Visual Perception Cognition		Correct reticle-target relationship	Resulting gun tube deflection offset
7.3.3. Engage target							
7.3.3.1. Engage point target with Cal .50		Apparent target size Target movement Visual conditions Tank movement		See 4.1	Opening time	No. of rounds within target area per total rounds fired	Target hit/miss
7.3.3.2. Engage area target with Cal .50		Apparent target size Target movement Visual conditions Tank movement			Opening Time	Accuracy of initial burst in target area Accuracy of subsequent bursts sweep	Target "effect" (killing burst followed by effective suppression)
///							
8. ENGAGE TARGET FROM LDR'S STATION			LDR				See 5.1
8.1. Engage point target with coax	TC's fire command	Apparent target size Target movement Visual conditions Tank movement		See 4.1	Opening time	No. of rounds within target area per total rounds fired	Target hit/miss
8.2. Engage area target with coax	TC's fire command	Apparent target size Target movement Visual conditions Tank movement			Opening Time	Accuracy of initial burst in target area Accuracy of subsequent bursts sweep	Target "effect" (killing burst followed by effective suppression)

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	PERFORMANCE MEASURES		
					SPEED	ACCURACY	OUTCOMES

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	SPEED	ACCURACY	OUTCOMES
9. ENGAGE MULTIPLE TARGETS							
9.1. Engage multiple main gun/coax targets (sequential)			CREW				
9.1.1. Engage multiple main gun/coax targets from gunner's station	Multiple target array	Number and type of targets / Target range and classification	GNR	Decision making	Opening/closing times	Correct engagement sequence	Hit/miss for each target
9.1.2. Engage multiple main gun/coax targets from TC's station	Multiple target array	Number and type of targets / Target range and classification	TC	Decision making	Opening/closing times	Correct engagement sequence	Hit/miss for each target
9.2. Engage multiple main gun/coax & machinegun targets simultaneous	Simultaneous target array	Target range and classification	TC, GNR	Decision making	Opening/closing times (each weapon)	Weapon/ammo selection	Hit/miss for each target
10. ADJUST DIRECT FIRE							
10.1. Observe fall of round	Round fired	Round velocity / Obscuration / Sensors/optics used / Parallax (NOTE 2)	CREW	Visual Perception / Cognition		Relationship between stated observation and actual fall of round with respect to target	Observation announcement
10.2. Announce subsequent fire command, REENGAGE, or CEASE FIRE	Gunner's observation/intended correction?	System status / Observation reliability	TC	Decision making / Verbal communication	Time from observation to subsequent FC	Accuracy of FC elements	Subsequent fire command
10.3. Employ reengagement or standard adjustment	TC's fire command	System status	GNR	Procedures	Time from subsequent FC to firing	Lay error of (subsequent round)	Target hit/miss (subsequent round)
11. TAKE IMMEDIATE ACTION				Procedural / Decision making		Correct procedure	Successful firing or isolation of malfunction
11.1. Perform main gun misfire procedure			CREW				
11.1.1. Perform main gun misfire procedure (attempt to fire with alternate triggers and manual firing device)	Main gun failure to fire	Nature of malfunction	GNR	Procedures / Gross motor skills	Time to fire after misfire	Attempted prior to other misfire actions	Successful firing
11.1.2. Perform main gun misfire procedure (attempt to fire with TC's power control handle)	Unresolved main gun failure following gunner's initial actions (11.1.1.)	Nature of malfunction	TC	Procedures / Gross motor skills	Time to fire after misfire	Attempted after gnr's actions	Successful firing

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	PERFORMANCE MEASURES		
					SPEED	ACCURACY	OUTCOMES
11.1.3. Perform main gun misfire procedure (rotate round)	Unresolved main gun failure following gunner's and TC's initial actions (11.1.1. and 11.1.2.)		LDR				
11.1.3.1. Unload main gun	Requirement to remove current round from breech	Tactical situation (Time pressure)	LDR	Gross motor skills	Time to remove and store round		Breech empty
11.1.3.2. Perform main gun manual extraction	Misfired round lodged in breech (extractor malfunction)	Tactical situation Prior physical activity (fatigue) How tightly round is lodged	LDR	Gross Motor skills	Time required to remove and store round		Breech empty
11.2. Perform machine gun failure to fire procedure (coax)	Coax failure to fire	Nature of malfunction	GNR	Procedures Gross motor skills	Time to fire after misfire		Successful firing
11.3. React to runaway firing (coax)	"Runaway" gun		GNR	Procedures Gross motor skills	Time to correct problem		Runaway halted
11.4. Perform machine gun failure to fire procedure (Cal .50)	Cal .50 machine gun failure to fire	Nature of malfunction Threat activity (return fire, artillery)	TC	Procedures Gross motor skills	Time to correct problem		Successful firing
11.5. Perform machine gun failure to fire procedure (loader's M240)	Loader's M240 machine gun failure to fire	Nature of malfunction Threat activity (return fire, artillery)	LDR	Procedures Gross motor skills	Time to correct problem		Successful firing
//							
12. EMPLOY SMOKE			TC, DVR				
12.1. Employ smoke grenades	Tank exposure to threat tank/AT systems	Wind direction/speed Own tank orientation/ aspect	TC	Decision making Procedures			Screening effect
12.2. Employ vehicle exhaust smoke screening system	TC's command to make smoke	Wind direction/speed Own tank orientation/ aspect	DVR	Procedures			Screening effect
//							
13. REPORT							
13.1. Provide spot report	Change in own tank/ enemy situation/status	Communications effectiveness Threat activity-- time available to submit report	TC	Cognition Verbal communication	Time on radio network	Adherence to RT procedures Correct assessment of situation, accuracy of reported location(s)	Report
13.2. Issue/receive report	Report from TC in platoon or from CO CMDR	Communications effectiveness Threat activity-- time available to submit report Comprehensibility of to-be-relayed report	PL	Cognition Verbal Communication	Time on radio network Time between original and relayed report	Adherence to RT procedures Correspondence of original and relayed spot report	Report

SUBTASK	INITIATING CONDITIONS	DIFFICULTY FACTORS	CREW MEMBER	SKILLS	PERFORMANCE MEASURES		
					SPEED	ACCURACY	OUTCOMES
14. ISSUE PLATOON FIRE COMMAND	Observation or report of threat target(s)	Type, range, and movement of threat tgts	PL	Decision making	Time from tgt exposure to fire command	Accuracy of platoon fire command elements	Platoon fire command
		Mission		Verbal Communication			
15. REQUEST INDIRECT FIRE			PL				
15.1. Request initial indirect fire	Expected or actual enemy contact	Tactical situation-- time avoid, enemy action		Cognition	Time on radio network	Correct elements in request for IDF	Initial IDF request
				Verbal Communication			
15.2. Shift/lift fire	Movement into threat position	Tactical situation-- time avoid, enemy action		Visual Perception	Time on radio network		No IDF on threat position
				Cognition			
16. SPECIFY MOVEMENT			PL				
16.1. Specify movement formation	Requirement to move tactically	Mission		Decision making		Appropriate- ness of choice	Specification of movement formation
		Known/suspected threat					
		Co OPORD/FRAGO					
		Terrain					
16.2. Specify movement technique	Requirement to move tactically	Mission		Decision making		Appropriate- ness of choice	Specification of movement technique
		Known/suspected threat					
		Co OPORD/FRAGO					
		Terrain					
16.3. Specify direction	Requirement to move tactically	Mission		Decision making		Appropriate- ness of choice	Specification of movement direction
		Known/suspected threat		Visual perception			
		Co OPORD/FRAGO					
		Terrain					

Appendix B

Results from K-Means Cluster Analyses of Crew-Level Subtasks

Table B-1

Summary of Analysis of Tank Commander Tests

Cluster Number / Short Subtask Title	Subtask Number	Descriptor Number
		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42
Cluster 1		
main gun misfire (TC tgr)	11.1.2	1 0 0 0 0 1 0 0 1 0 1 1 1 1 1 1 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
observe fall of round	10.1	1 1 1 1 0 1 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 1 1 0 0 0 1 0 1 0 0 0 0 1
engage simultaneous targets	9.2	1 1 1 0 1 1 0 0 1 0 0 1 1 1 1 1 1 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 1 0 0 0 0 0 1
range to target with TC weapon	2.3.2	1 0 0 0 1 1 0 0 0 0 0 1 1 1 1 1 0 1 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 1 0 0 1 0 1
engage mult main gun tgt (TC)	9.1.2	1 0 0 0 0 0 0 0 1 0 0 1 1 1 1 1 0 1 0 1 0 0 0 0 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 0 0 1
lay main gun for direction	3.1.2	1 0 0 0 1 0 0 0 1 0 0 1 1 1 1 1 1 0 0 1 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 1 0 0 0 0 1
fire at area Cal .50 target	7.3.3.2	1 0 0 0 0 1 0 0 0 0 0 1 1 1 1 1 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
mark target with TC weapon	3.1.3.2	1 0 0 0 1 1 0 0 1 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 1 0 1 0 0 0 0 1
fire at point Cal .50 target	7.3.3.1	1 0 0 0 0 1 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1
issue battlesight fire command	3.2	1 0 0 0 1 1 0 0 1 0 0 1 1 1 1 1 1 1 0 1 0 0 0 0 0 0 1 0 0 1 0 1 1 0 1 0 0 1 0 0 0 1
lead moving Cal .50 target	7.3.2	1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1
specify simultaneous engmnt	3.4	1 0 0 0 1 0 0 0 1 0 0 1 1 1 1 0 1 1 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1
fire at Cal .50 target	7.3.1	1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 0 0 1 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 1 0 0 0 0 1
track main gun target (TC)	7.1.2	1 0 0 0 1 1 0 0 1 0 0 1 1 1 1 1 1 1 0 1 0 0 0 0 0 0 1 0 0 1 0 1 0 0 1 0 0 0 0 0 0 1
index rng w/ add/drop toggle	6.1.2.1	1 0 0 0 0 0 1 1 0 0 0 1 1 1 1 1 1 0 1 0 0 0 0 0 0 0 1 0 0 0 1 0 0 1 0 0 1 0 0 0 0 1
engage area coax target (TC)	7.2.2	1 0 0 0 1 1 0 0 1 0 0 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1
issue standard fire command	3.1.1	1 0 0 0 0 0 0 1 0 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 1 1 0 0 0 1
engage point coax target (TC)	7.2.1	1 0 0 0 1 1 0 0 0 0 0 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1
specify range in FC	3.1.4	1 0 0 0 0 0 0 0 1 0 0 1 1 1 1 1 1 1 0 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 0 1 0 0 0 0 1
fire at main gun target (TC)	7.1.4	1 1 0 0 0 0 0 0 1 0 0 1 1 1 1 1 1 0 0 1 0 0 0 0 0 0 2 1 0 2 0 1 0 0 0 0 1 1 0 0 0 2
apply lead to moving target	6.1.5	1 1 0 0 1 0 0 0 0 0 0 1 1 1 1 1 1 0 1 1 0 0 0 0 0 0 1 0 0 0 1 0 1 0 0 0 0 0 0 0 0 1
lase to target (TC)	7.1.3	1 0 0 0 0 0 0 0 1 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 1 0 1 0 0 0 0 1
specify direction verbally	3.1.3.1	1 0 0 0 0 1 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 2 0 0 1 0 0 0 1 0 0 0 0 1
manually index range	6.2	1 1 0 0 1 0 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 0 0 0 1 0 0 0 1
specify mult tgt eng sequence	3.3	1 0 0 0 0 0 0 0 1 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1
estimate range visually	2.3.1	1 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1
Cluster 2		
Cal .50 fail-to-fire procedure	11.4	1 0 0 0 0 1 1 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 1 0 0 1 0 1 0 0 1 0 0 1
Cluster 3		
announce SFC/REENGAGE	10.2	1 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 1 0 1 0 0 0 0 0 0 0 1 0 0 1 0 1 0 0 1 0 0 0 0 1 1 0
direct tank movements	4.2.1	1 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0
report	13.0	1 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 1 0 1 1 0 0 0 1
employ smoke grenades	12.1	1 0 0 0 1 0 0 0 0 2 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 1 0 0 1
set FCS switches (TC)	7.1.1	1 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 1 0 0 1 0 0 0 1

Cluster Number Short Subtask Title	Subtask Number	Descriptor Number 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42
Cluster 4		
choose deg mode technique	6.1	1 0 0 0 0 0 0 1 0 0 0 0 1 1 1 1 0 0 0 1 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 1
Cluster 5		
search using thermal	2.1.3	1 1 0 0 1 1 0 0 1 0 0 0 1 1 1 1 0 1 0 0 0 0 0 0 0 1 0 0 1 0 0 1 0 0 1 0 1 0 0 0 0 0
search--open hatch	2.1.5	1 0 1 0 1 0 0 0 1 0 0 0 1 1 1 1 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0
search using daylight	2.1.2	1 1 0 1 1 1 0 0 1 0 0 0 1 1 1 1 0 1 0 0 0 0 0 0 1 0 0 0 1 0 0 1 0 0 1 0 1 0 0 1 0 0
locate/recognize targets	2.2	1 1 1 0 0 0 0 1 1 0 0 0 1 1 1 1 0 1 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 1 0 0 1 0 1 0 0
search--closed hatch	2.1.4	1 0 1 1 0 0 0 0 1 0 0 0 1 1 1 1 0 1 0 0 0 0 0 0 1 0 0 0 1 0 0 1 0 0 1 0 1 0 0 1 0 0

Notes. One (1) indicates presence of descriptor characteristics, whereas zero (0) indicates its absence. Asterisks indicate the descriptors that significantly discriminate among the clusters, p < .05.

B-2

Table B-2

Summary of Analysis of Gunner Tasks

Descriptor Number

Cluster Number / Short Subtask Title	Subtask Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Cluster 1																																											
apply range in GAS	6.1.4	0	1	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	1	0	0	0
choose sight for search	2.1.1	1	1	1	0	0	1	0	0	1	0	0	1	1	1	1	0	1	0	1	0	1	0	0	1	1	1	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	0
apply lead to moving target	6.1.5	1	1	0	0	0	1	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1
search using thermal	2.1.3	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	1	1	0	1	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0
manual cont hndls/bistng mech	6.1.6	0	1	0	0	0	1	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	1	1	0	0	1
search using daylight	2.1.2	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0
identify specified tgts	4.1.2	0	1	0	0	0	1	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
min gun misfire (alt/man tgr)	11.1.1	0	1	0	0	0	1	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1
track main gun target (GNR)	4.1.3	1	1	1	0	1	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	1
observe fall of round	10.1	1	1	1	1	0	1	0	0	1	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0
lase to target (GNR)	4.1.4	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0	1	0	0	1	1	0	1	0	1	0	1	0	0	0	1	0	0	1	1
engage mlt main gun tgt (GNR)	9.1.1	0	1	0	0	1	1	0	0	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1	0	0	1	0	0	0	0	0	1
fire at main gun target (GNR)	5.1.1	1	1	0	0	1	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0
locate/recognize targets	2.2	1	1	1	1	1	1	0	0	1	0	0	1	1	1	1	1	1	0	0	1	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0
clear terrain mask	4.2.2	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0
engage simultaneous targets	9.2	0	2	0	0	2	2	0	0	1	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	0	1	0	1	1	0	0
engage point coax target (GNR)	5.1.1	1	1	0	0	1	1	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	1	0	0	1	0	0	0
manually index range	6.2	1	1	0	1	0	0	0	0	1	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0
employ reengagement or std adj	10.3	0	1	0	0	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
engage area coax target (GNR)	5.1.2	0	0	0	0	0	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0	1	1
Cluster 2																																											
set FCS switches (GNR)	4.1.1	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1
index range thru CCP	6.1.2.2	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	1	1	0	0	1
Cluster 3																																											
react to runaway coax	11.3	0	1	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	1	1	0	0	1	0	0	0
coax fail-to-fire procedure	11.2	0	1	0	0	1	1	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	1	0	0	1	0	1	1	0	0	1	0	0	1
Cluster 4																																											
choose appropriate sight	6.1.3	0	1	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	1

Notes. One (1) indicates presence of descriptor characteristics, whereas zero (0) indicates its absence. Asterisks indicate the descriptors that significantly discriminate among the clusters, p < .05.

B-3

Table B-3

Summary of Analysis of Loader Tests

Cluster Number / Short Subtask Title	Subtest Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Cluster 1																																											
unload main gun	11.1.3.1	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	1	0	0	1
load rnd	4.3	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
main gun rnd extraction	11.1.3.2	0	0	1	0	0	1	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0
engage area ldr's M240 target	8.2	0	0	0	1	0	0	0	0	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	1	0	1	0	0	0	1
engage point ldr's M240 target	8.1	0	0	0	0	0	1	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1
ldr's M240 fail-to-fire proc	11.5	0	0	1	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1
monitor coax ammo feed	5.2	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	1
Cluster 2																																											
observe fall of round	10.1	1	1	1	1	0	0	0	0	1	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0
search--open hatch	2.1.5	1	1	0	1	1	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	1	1	0
locate/recognize targets	2.2	1	1	1	1	0	0	0	1	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	0	0	0
search--closed hatch	2.1.4	1	0	1	1	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0

Table B-4

Summary of Analysis of Driver Tasks

Cluster Number Short Subtask Title	Subtest Number	Descriptor Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Cluster 1																																											
search--open hatch	2.1.5	1	0	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	0	0	1	0	0	0	0
drive tactically	4.2.3	0	0	1	1	1	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	1
locate/recognize targets	2.2	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
observe fall of round	10.1	1	1	1	1	0	0	0	0	1	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	1	0	0	0	1	1	0	0
search--closed hatch	2.1.4	1	0	1	1	0	0	0	1	0	1	0	1	1	1	1	1	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	0	1	1	1	0	0
use cover and concealment	4.2.4	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0	1	0	0	1	1
Cluster 2																																											
employ veh exhaust screen	12.2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	1

Notes: One (1) indicates presence of descriptor characteristics, whereas zero (0) indicates its absence. In this analysis, none of the descriptors significantly discriminated between the clusters.

B-5

Appendix C

Preliminary Lists of Platoon Collective Subtasks

Table C-1

Subtasks Identified Through Analysis of Doctrinal Data

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1. Move Tactically Using the Wingman Concept
2. Execute Action Drill
3. Execute Contact Drill
4. Engage Multiple Targets
5. Form a Platoon Line
6. Form a Platoon Wedge
7. Form an Echelon
8. Move Using Bounding Overwatch
9. Move into an Initial Battle Position
10. Manuever Within a Battle Position
11. Manuever to a Subsequent/Alternate Battle Position
12. Assault an Enemy Position
13. Conduct an Attack by Fire
14. Establish Security

Table C-2

Subtasks Identified Through Analysis of Platoon Functions

1.1. Establish/Change Platoon Movement Technique in Accordance with METT-T
1.2. Establish/Change Platoon Formation in Accordance with METT-T/Movement Technique
1.3. Move in Platoon Formation (Traveling, Traveling Overwatch)
1.4. Move by Section/Platoon (Bounding Overwatch, Fire and Manuever)
1.5. Select/Modify Platoon Route of Movement (Axis) in Accordance with METT-T
1.6. Establish Sectors of Observation in Accordance with Company-Team/Platoon Movement Technique and Formation

2.1. Select Modify Platoon Position in Accordance with METT-T
2.2. Occupy Platoon Position from Flank or Rear
2.3. Improve Platoon Position
2.4. Establish/Change Sectors of Observation in Accordance with METT-T
2.5. Search in Sector/Overwatch Bounding Element
2.6. Move Out of Platoon Position

3.1. Establish/Adjust Platoon Fire Technique in Accordance with METT-T
3.2. Engage and Observe Platoon Fires
3.3. Establish/Adjust Platoon Fire Pattern in Accordance with METT-T
3.4. Engage Targets in Accordance with Platoon Fire Pattern
3.5. Engage on Movement (Action on Contact, Battle Drill, Assault)

4.1. Signal Movement Progress
4.2. Coordinate Movement With Adjacent/Supporting Units
4.3. Request/Adjust Indirect Fires
4.4. Report Contact
4.5. Transmit SPOTREP
4.6. Report Status

Appendix D

Crosswalk of Subtasks to Threat Scenarios

Table D-1

Individual and Crew Tasks

Subtasks	Attack vs. Defend						Meeting Engagement vs. Defend						Meeting Engagement vs. Attack						Deliberate Defense vs. Attack						Withdrawal vs. Attack						Breakthrough vs. Defend						Refer to Number
	1.0	1.1	1.2	1.3	1.4	1.5	1.6	2.0	2.1	2.2	2.3	2.4	2.5	2.6	3.0	3.1	3.2	3.3	3.4	3.5	3.6	4.0	4.1	4.2	4.3	4.4	4.5	4.6	5.0	5.1	5.2	5.3	5.4	5.5	5.6	6.0	6.1	6.2	6.3	6.4	6.5	6.6	Comments Attached

2. Acquire Target
   2.1. Search/Detect
   2.1.1. Choose sight
   2.1.2. Daylight sight
   2.1.3. Thermal sight
   2.1.4. Search closed-hatch
   2.1.5. Search open-hatch
   2.2. Locate/ID target
   2.3. Estimate range
   2.3.1. Est. range visually
   2.3.2. Range to tgt/.50 cal

3. Issue Fire Command
   3.1. Standard fire command
   3.1.1. Issue standard fire command
   3.1.2. Lay main gun for direction
   3.1.3. Specify direction
   3.1.3.1. Verbally
   3.1.3.2. W/TC weapon
   3.1.4. Specify range
   3.2. Issue battlesight
   3.3. Specify multiple target
   3.4. Specify simultaneous

4. Engage Single Main Gun Target Using Precision Gunnery[a]
   4.1. Fire main gun
   4.1.1. Set FCS switches
   4.1.2. ID target
   4.1.3. Track
   4.1.4. Lase
   4.1.5. Fire
   4.2. Maneuver
   4.2.1. Direct tank movement
   4.2.2. Clear terrain mask
   4.2.3. Maintain platform
   4.2.4. Use cover and concealment
   4.3. Load round

(table continues)

Subtasks	Attack vs. Defend							Meeting Engagement vs. Defend							Meeting Engagement vs. Attack							Deliberate Defense vs. Attack							Withdrawal vs. Attack							Breakthrough vs. Defend							Refer to Number Comments Attached
	1.0	1.1	1.2	1.3	1.4	1.5	1.6	2.0	2.1	2.2	2.3	2.4	2.5	2.6	3.0	3.1	3.2	3.3	3.4	3.5	3.6	4.0	4.1	4.2	4.3	4.4	4.5	4.6	5.0	5.1	5.2	5.3	5.4	5.5	5.6	6.0	6.1	6.2	6.3	6.4	6.5	6.6	
5. Engage [Single] CDAX Target Using Precision Technique																																											
5.1. Engage target	0	0	0	2	0	0	2	0	0	0	2	2	0	2	0	0	0	2	0	0	2	0	0	2	0	0	0	2	0	0	0	2	0	0	2	2	2	2	2	2	2	2	
5.1.1. Engage point	0	0	0	2	0	0	2	0	0	0	2	2	0	2	0	0	0	2	0	0	2	0	0	2	0	0	0	2	0	0	0	2	0	0	2	2	2	2	2	2	2	2	
5.1.2. Engage area	0	0	0	2	0	0	2	0	0	0	2	2	0	2	0	0	0	2	0	0	2	0	0	2	0	0	0	2	0	0	0	2	0	0	2	2	2	2	2	2	2	2	
5.2. Monitor ammo	0	0	0	2	0	0	2	0	0	0	2	2	0	2	0	0	0	2	0	0	2	0	0	2	0	0	0	2	0	0	0	2	0	0	2	2	2	2	2	2	2	2	11.
6. Engage [Single] Target Under Degraded Conditions																																											12.
6.1. Choose technique	0	1	1	1	0	1	1	0	1	1	1	0	1	1	0	0	1	1	0	1	1	0	0	1	1	0	1	1	0	1	1	1	0	1	1	0	0	0	0	0	0	0	
6.1.1. Manually index range	0	1	1	1	0	1	1	0	1	1	1	0	1	1	0	0	1	1	0	1	1	0	0	1	1	0	1	1	0	1	1	1	0	1	1	0	0	0	0	0	0	0	
6.1.1.1. Toggle range	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14., 15.
6.1.1.2. Enter CCP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	14., 15.
6.1.2. Choose sight	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	16.
6.1.3. Apply range in GAS	0	1	1	1	1	1	1	0	1	1	1	1	1	1	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	16., 17.
6.1.4. Lead moving target	0	1	1	1	0	1	1	0	1	1	1	0	1	1	0	0	1	1	0	1	1	0	0	1	1	0	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	18.
6.1.5. Use manual controls	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	19.
6.2. Use multiple return strategies	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	20.
7. Engage Target from TC Position																																											21.
7.1.1. Set switches	0	1	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	
7.1.2. Track target	0	1	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	21., 22.
7.1.3. Lase	0	1	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	
7.1.4. Fire	0	1	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	
7.2. Engage CDAX	0	0	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	
7.2.1. Point target	0	0	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1	0	0	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	23.
7.2.2. Area target	2	2	2	2	0	2	2	0	0	2	2	0	2	2	0	0	2	2	0	2	2	0	2	2	2	0	2	2	0	2	2	2	0	2	2	2	2	2	2	2	2	2	24.
7.3. Engage Cal .50	2	2	2	2	0	2	2	0	0	2	2	0	2	2	0	0	2	2	0	2	2	0	2	2	2	0	2	2	0	2	2	2	0	2	2	2	2	2	2	2	2	2	25.
7.3.1. Apply range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.3.2. Lead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.3.3. Engage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7.3.3.1. Point target	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26.
7.3.3.2. Area target	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	26.
8. Loader Target																																											26.
8.1. Engage point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26.
8.2. Engage area	0	0	0	1	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	26.

(table continues)

Subtasks	Attack vs. Defend 1.0 1.1 1.2 1.3 1.4 1.5 1.6	Meeting Engagement vs. Defend 2.0 2.1 2.2 2.3 2.4 2.5 2.6	Meeting Engagement vs. Attack 3.0 3.1 3.2 3.3 3.4 3.5 3.6	Deliberate Defense vs. Attack 4.0 4.1 4.2 4.3 4.4 4.5 4.6	Withdrawal vs. Attack 5.0 5.1 5.2 5.3 5.4 5.5 5.6	Breakthrough vs. Defend 6.0 6.1 6.2 6.3 6.4 6.5 6.6	Refer to Number Comments Attached

9. Engage Multiple Targets [b]
 9.1. Engage main gun and/or COAX targets (sequential targets)
  9.1.1. Gunner's station
   9.1.1.1. Main gun
   9.1.1.2. COAX — 27.
  9.1.2. TC position
   9.1.2.1. Main gun
   9.1.2.2. COAX
 9.2. Engage Simultaneous Targets
  9.2.1. Main gun/cal .50 — 28.
  9.2.2. COAX/cal .50 — 28.

10. Adjust Fire
 10.1. Observe round — 28.
 10.2. Give subsequent command — 28.
 10.3. Employ adjustment

11. Take Immediate Action
 11.1. Main gun misfire — 29.
 11.2. COAX failure — 29.
 11.3. Runaway COAX — 29.
 11.4. Cal .50 — 29.
 11.5. Loader's M240 — 28., 29.

12. Employ Smoke
 12.1. Grenades — 30.
 12.2. Exhaust — 30.

13. Report
 13.1. TC Report

PL/PSG TASKS
 13.2. Reports

14. Issue Platoon Fire Command

15. Request Indirect Fire
 15.1. Initiate — 31.
 15.2. Lift/shift — 31.

16. PLT Movement
 16.1. Technique — 32.
 16.2. Formation — 32.
 16.3. Direction — 32.

Note: Subtasks are coded as follows: "2" indicates that the subtask can be trained and/or tested in the scenario; "1" indicates it can be trained and/or tested in the scenario if additional conditions are added; and "0" indicates that it cannot be trained in the scenario under any circumstances.

[a] Because this is the basic building block engagement, ratings are made as though number of targets is irrelevant.

[b] Also see 4, 5, 6, and 7.

Cmt. No.	Task No.	Comment
1.	2.1.1. 2.1.2. 2.1.3.	When using the GPS/GPSE to search and acquire targets, the TC/GNR can choose to be in either daylight or thermal. The choice of one eliminates the other. Conventional doctrine dictates acquiring in thermal and confirming in daylight. Some platoon sections however, will put one tank in thermal and the other in daylight. Left on their own, gunners will generally choose to operate in daylight, particularly when moving, because of the difficulty of orienting in thermal. Also, as acquisition becomes easier, as happens at closer ranges and when the Blue is in the defense, crews rely less on thermal. Thermal can be forced throughout by night operations and somewhat, although not completely, by utilizing Enhancement G. Daylight can be forced throughout by inducing a GPS daylight channel failure. But the goal is not to use one and exclude the other but to combine the two as befits the situation. The proper employment of sight choice is affective. It should also be noted that to encourage thermal use, a strong, identifiable thermal signature is required and the corresponding visual signature should be comparatively weak.
2.	2.1.4. 2.1.5.	TC will tend to stay open hatch or pop hatch until small arms or overhead fires force him to go closed hatch. It is assumed that small arms fires will not become a factor until close (400 m) ranges. The driver should be closed hatch throughout any offensive operation and as soon as any engagement starts on the defense. In reality, crew members do not close their hatches unless ordered to or forced to. Enhancement D will require closed hatch operation as long as it is in effect. Enhancement F will also require the crew to go closed hatch but this Enhancement is very short. During night operations, the loader will be continuously closed hatch, assuming he has the AN/VVS-2 installed. Two considerations are at work when considering open hatch/closed hatch: First, the crews (and TC in particular) want to enhance control and target acquisition and this means open hatch. Second, the crews want to enhance protection and must be capable of performing all functions buttoned up and this means training closed hatch. So the two choices are sometimes conflicting. Certainly good crews (again particularly the TC) will alternate depending on the situation.
3.	2.3. 2.3.1.	As a mental exercise, this is something the TC should be doing constantly for reporting purposes and to confirm LRF returns in the likely occurrence of a multiple return bar. But as a gunnery technique, this is only specifically required prior to inclusion in a fire command. Therefore, to insure that this occurs, an LRF failure must be induced.

Cmt. No.	Task No.	Comment
4.	2.3.2.	Although this exists as a ranging technique, it is slow, not very accurate, alerts the enemy, reveals own location, and wastes Cal .50 ammunition. It is probably seldom, if ever, used for this purpose. It requires an LRF failure to be induced but that does not insure this method will be used. Most, if not all, TC will rely on visual estimation.
5.	3.	During this and all subsequent gunnery tasks, it is assumed that no actual acquisition will take place at the 3000 meter range line.
6.	3.1.3.1.	This is normally performed when the TC is unable to lay the gun in the vicinity of the target for the gunner. The most obvious time for this is when there is a turret power failure. Then, the method of choice is talking the gunner onto the target. The TC may choose to talk a gunner onto target at other times as well, for example, the gunner cannot identify, and the TC chooses not to take over the engagement - but these other situations cannot be relied on to occur.
7.	3.1.4.	The TC will specify the range only when the range is not automatically introduced as part of the ballistic solution. This is most likely to occur when there is an LRF failure or the GPS is inoperative. Both these failures must be induced. The use of Enhancement G can affect the reliability of the LRF but it is difficult to elicit consistent behaviors with this method.
8.	3.2.	There are two general situations in which battlesight will be used. The first of these is when range is not being computed as part of the ballistic solution and the target is within 1600 meters (APFSDS) and 1100 meters (HEAT). This will generally occur with an LRF failure, which must be induced. It should be noted that, with an LRF failure, a TC need not always go to battlesight: he may index range himself (toggle); he may have the gunner index range; or he can announce range and the gunner can use the GAS. Although battlesight is quicker, it is not the only choice. The second likely battlesight situation is when all systems are operational, but the tank is likely to acquire surprise targets within 1600 meters (1100 meters HEAT). The primary concern here is speed. This situation was judged most likely to occur during Scenarios 3 and 6.

The use of Enhancement G will increase the likelihood of battlesight being used in both situations. |

Cmt. No.	Task No.	Comment
9.	4.1.3.	Tracking will reduce to a rating of "0" in those instances that both Blue and Red are stationary at acquisition and engagement.
10.	4.2.3.	As a gunnery technique, this generally only applies when the firing tank is acquiring and firing on the move. This is more likely in offensive situations. Even if the TC commands "Driver Stop" anytime during the engagement, the task should be considered to be required. However, if no part of acquisition or engagement occurs while moving, the rating will reduce to "0".
11.	5.2	This is the loader's task and should be occurring whenever the COAX is fired. However, as with many tasks, it is notable only when it does not occur, such as when the COAX runs out of ammo or a preventable feeding problem occurs. It can involve very passive behavior on the part of the loader and there is no real method to insure it occurs. It is also very unlikely to occur in situations other then actual live fire.
12.	6. 6.1	Degraded mode gunnery compensates for a fire control malfunction that prevents the computer from automatically applying a full ballistic solution. The surest way of requiring degraded gunnery performance is by inducing it into the fire control system, although some failures (particularly LRF) can be environmentally induced. Malfunctions generally are considered of two types: The first is known to exist before the engagement and the TC/GNR make plans to compensate before the target is even encountered. The second occurs spontaneously, usually during the engagement, and the TC/GNR must react to make the engagement successful.
13.	6.1.	The specific technique selected to deal with a malfunction depends primarily on the type of malfunction induced, but also on when the malfunction occurs or is discovered. Generally, there are nine primary malfunctions trained for: (LRF malfunction, symbology loss, crosswind sensor failure, cant sensor failure, LAS failure, day channel failure, TIS failure, stab failure, and turret power failure). These can occur in isolation, in combination, or in any series of combinations.

Cmt. No.	Task No.	Comment
14.	6.1.1. 6.1.1.1.	This requires inducement of some type of LRF failure. Normally, this will be performed beyond 1600 meters (1100 meters HEAT) and will be more prevalent in defensive situations where, depending on the defensive posture, it may continue down to 1000 meters. In most engagements within 1600 meters (1100 meters HEAT), and particularly on the offense, the solution will be to go battlesight. It should also be noted that the TC also, at all ranges and situations, has the option of going to the GAS. Thus the only way of absolutely insuring that manual indexing occurs is to induce an LRF failure, make the GAS unavailable, and have the target beyond 1600 meters.
15.	6.1.1. 6.1.1.2.	When range is going to be manually indexed, and all other considerations are equal, the TC will normally use the ADD/DROP switch, primarily because of speed. For the gunner to index the range, the gunner must open the CCP door, turn on the CCP, press the RANGE key, press the number keys corresponding to the range announced by the TC, press the ENTER key, and again press RANGE. To force the gunner to index range would require a manual index situation coupled with an inoperative ADD/DROP switch or a loss of range readout in the GPSE.
16.	6.1.2. 6.1.3.	The gunner has essentially a choice of 3 sights: In the primary sight he may use either the daylight channel or thermal. Or he may use the GAS. Any of these three choices can become inoperative. The order of selection is GPS-DL, GPS-Thermal (this may be reversed under some conditions, e.g., night), and GAS. If operating with a 3-man crew, the TC has only the two GPSE options.
17.	6.1.3.	Generally, the gunner will only use the GAS when he cannot use the GPS daylight channel and the TIS. Whenever the GAS is used he must apply a range.
18.	6.1.4.	This can be required if a LAS failure is induced. It is also required whenever the GAS is used. However, in any case it is required only when movement is involved. If the firing tank and the target are stationary, the rating will reduce to "0".
19.	6.1.5.	A turret power failure will require use of manual controls (as well as requiring use of the GAS and precluding the TC from laying on target). Some electrical or hydraulic failures, short of total turret power failure, may also require the gunner to use manual.

Cmt. No.	Task No.	Comment
20.	6.2.	The computer "reads" the return of the signal of the LRF and displays the range it inputted. If the LRF received more than one return reading, it will display a multiple return bar. This does not mean that the range inputted was incorrect. The TC/GNR must evaluate the range displayed, compared with other external indicators of range, and decide whether to accept the range displayed or rerange (possibly also changing ranging logic), or use another method to input range. Multiple returns can be caused by smoke, dust, or heavy precipitation. It can also result from a very small target (beam spillover) or interference from in front of or behind the target, such as vegetation. Enhancement G will increase the incidence of multiple returns although there is little that can be done to "guarantee" their occurrence.
21.	7. 7.1.2.	The TC has three weapons choices that he can control from his position. First he has the TC weapon (almost always a Cal .50 M2 machinegun), which he alone can employ. Second and third, he can use the TC override to engage with the main gun or the COAX. The later two options are required whenever the tank is operating with a 3-man crew. The TC may also choose to engage from his position (with main gun or coax) if the gunner fails to identify or to otherwise engage the target satisfactorily. Whether the TC exercises this option or not depends much on the situation, threat pressure, and time available. If the TC takes over the engagement, he is not free to control the vehicle, search for other targets, report, or monitor the section/platoon situation. Therefore, even if a gunner fails to initially identify, the TC may elect to take the time to talk him on target rather then immediately assuming control. Thus, the only way to insure TC main gun/COAX engagement is to impose a 3-man crew.
22.	7.1.2.	This rating will reduce to "0" in those instances where both the firing tank and the target are stationary.
23.	7.3.	The .50 is used on targets out to 1800 meters. However, other considerations being equal (such as the ability to destroy the target and the absence of competing targets) at ranges within 900 meters, the weapon of choice should be the coax because of the disparity in ammunition restock available for the two machineguns. The CWS .50 is a difficult weapon to control particularly against point targets. In most situations, firing the .50 is done when stationary, using a short halt as necessary in an otherwise moving situation.

Cmt. No.	Task No.	Comment
24.	7.3.1.	The TC will normally make a preliminary visual estimation of the range. The .50 CWS sight is marked in 400 meter increments; other ranges must be interpolated on the sight. After the approximate lay on the estimated range, the TC adjusts on the initial burst of tracer.
25.	7.3.2.	Lead is only applied against moving point targets.
26.	8. 8.1. 8.2. 11.5.	The loader's primary responsibility is to load the main gun and, when not doing that, to act as another pair of eyes for the TC. He is provided a machinegun but the primary purpose of that weapon is air defense, not ground targets, where his effective area of defense is a limited area to the left side of the tank. The loader's machinegun lacks the controls and sight to be effectively employed against point targets. Because of the heavy concentration of main gun targets in these scenarios, a very special situation would have to be created to actually direct the loader to engage ground area targets.
27.	9.1.2.	To generate the TC engaging sequential main gun/COAX targets requires special conditions. The only way to insure this occurring is to impose a 3-man crew.
28.	10. 10.1. 10.2. 10.3.	All main gun rounds fired should be observed by both the gunner and the TC. (Standard observations are target, lost, doubtful, over, and short.) Primary responsibility for subsequent rounds rests with the gunner and he should announce both his observation and his actions. If a target is missed, and all systems are operational, the gunner should automatically announce "REENGAGE", and lay, lase, and fire as with a new target. If in a degraded mode, but using the GPS, the gunner automatically applies the standard adjustment method by announcing and applying a one mil add or drop and a one mil left or right depending on his sensing. If in a degraded mode, but using the GAS, the gunner automatically applies the standard adjustment method by announcing and applying a 200 meter add or drop and a one mil left or right depending on his sensing.

Cmt. No.	Task No.	Comment
28.(Cont.)	10.	The TC has essentially 3 choices on a miss. First, he can do nothing in which case the gunner should apply one of the three "automatic" responses, depending on the equipment being employed. Second, the TC, if he disagrees with the observation or the action announced by the gunner, can issue a subsequent fire command. Third, he can order the gunner to reengage, that is, relay to the original aiming point, release (if possible) and refire. It should be noted that the command to reengage should only be necessary in a degraded mode; in precision gunnery it should be the gunner's automatic response to a miss.

It should be noted that APDS-type ammunition cannot be observed at ranges of less then 2000 meters, although target/impact area effects can be evaluated. Likewise, environmental conditions can affect the ability to observe HEAT at any range. The observation in such cases will generally be a "lost" and the correct response in most cases of a "lost" will be to reengage.

To recap the conditions to require adjust fire, first, a miss is required. What occurs then will depend on what type of ammunition, the range, what the crew observed, differences in observations, and the status of the fire control system. To make certain controlled events occur will require the introduction of specific instructions and directions. |
| 29. | 11.
11.1.
11.2.
11.3.
11.4.
11.5. | Immediate action is those steps taken to restore a weapon system to a firing status. In the case of most machineguns, it involves charging the weapon, insuring the ammunition is feeding, and the round is chambering, and attempting to refire. In the case of the main gun, it involves all turret members of the crew and can ultimately involve removing the round (or evacuating the tank under some conditions). Some situations, like a runaway machinegun, are very difficult to introduce. Others can be introduced but not on a random or surprise basis like will happen on the job; the crew will have to be instructed that a certain situation is about to occur, particularly for main gun misfire drills. |

D-10

Cmt. No.	Task No.	Comment
30.	12. 12.1. 12.2.	The individual tank has two sources of producing its own obscuration: First is the M250 smoke grenades. Second is the VEESS. Both have limitations. The number of grenades available is limited and M250 grenades are a threat to friendly vehicles and troops within range. The VEESS uses fuel at an excessive rate. Both can pinpoint friendly locations and require immediate movement. The effective use of both is highly dependent on wind direction and speed and must take into account one's own route and mission and the enemy location. Smoke is effective in providing protection against helicopters, as introduced by Enhancement B, particularly at extreme ranges. Smoke should be used when exiting a BP. It should also be used on the offense when ATGM are anticipated or encountered. Probably more situations exist to employ smoke than there is smoke to employ. This is particularly true in training situations where prolonged exposure to red phosphorous smoke or poorly combusted diesel can cause health and environmental concern. The critical part of using on-board smoke is not in pushing the buttons to make the smoke appear; it is in the when, where, and how of employment.
31.	15. 15.1. 15.2.	The platoon has access to two sources of indirect fire. The first is the battalion mortar section and the second is the field artillery battalion which will be DS to the brigade. That battalion will have a FIST operating at the company (Team) level. Although the PL/PSG can initiate an initial call for fire (or shift from known point) on targets of opportunity, such calls in the Scenarios depicted would be rare. More likely, the company commander and FIST will pre plan indirect fires in both the offense and the defense and the platoon leader will then be provided a target priority list. He may then request those targets be fired at a particular time. The company commander and the FIST will decide if he will receive the support based on the situation and the availability. The PL will generally not have to submit a formal call for fire in these situations. Under some very special conditions, the platoon leader may have to lift or shift fires as movement occurs. Realistically, the platoon will get only very limited control over indirect fires and very limited availability. They are such a valuable and limited resource that most control will remain with the TL.

Cmt. No.	Task No.	Comment
31.(Cont.)		To require the platoon to call in preplanned fires means he must be given the availability of those fires in the first place, most likely in the OPORD.
32.	16.1. 16.2. 16.3.	Requirement to move to alternate battle position is driven by Blue tactical situation--based either upon disengagement criteria in company/team operations order, or upon FRAGO during exercise. Movement may be by sections or simultaneous.

Table D-2

Platoon Collective Tasks

Table columns (left to right): Attack vs. Defend | Meeting Engagement vs. Defend | Meeting Engagement vs. Attack | Deliberate Defense vs. Attack | Withdrawal vs. Attack | Break Through vs. Defend | Refer to Number Comments Attached

Subtasks	Refer to Number Comments Attached
1. Travel in Plt Formation	
1.1. Wedge	1.
1.2. Echelon	1.
1.3. Line	2.,3.
1.4. Vee	
1.5. Column/Stag. Column	4.,5.
2. Execute Battle Drills	
2.1. Action Drill	6.
2.2. Contact Drill	7.,8.
2.3. Air Attack Drill	9.
3. Bound by Section	10.,11.
4. Overwatch Bounding Plt	12.
5. Occupy BP	
5.1. Initial	
5.2. Subsequent	
6. Maneuver Within BP	13.
7. Employ Fire Pattern	
7.1. Frontal	14.
7.2. Cross	15.
7.3. Depth	16.
8. Employ Firing Technique	
8.1. Observed	17.
8.2. Alternat'g	18.
8.3. Simultaneous	

Cmt. No.	Task No.	Comment
1.	1.1. 1.2.	Wedge or echelon preferred when enemy situation vague (enemy position unknown). In Red Meeting Engagement/Blue Attack Scenario (3), other enemy forces may join battle from flanks at any time during engagement, therefore wedge/echelon more likely during these engagements.
2.	1.3.	Line formation appropriate for assaults and offensive maneuver against known enemy position. Assault not preferred unless force ratio favors blue 3:1.
3.	1.3.	Insufficient force ratio for assault unless smaller enemy force portrayed.
4.	1.5.	Column formation typical for movement to subsequent battle positions. Company/Team may initiate movement earlier against larger enemy force (Scenarios 1.1, 1.4) than against smaller enemy force (Scenarios 2.1, 2.4).
5.	1.5.	Column formation may be forced by scenario Enhancement E--Enemy Obstacle, particularly if platoon is breach or assault force.
6.	2.1.	Action drill appropriate if force ratio favors friendly--2:1 or better preferred. At 2000 and 1000 meter lines, blue force would maneuver toward enemy and seek cover in that general direction. At 400 meter line, Blue force would transition to assault.
7.	2.2.	Contact drill possible during movement to subsequent battle position: enemy encircling force (3-5 vehicles) encountered enroute.
8.	2.2.	Contact drill appropriate when contact has not been made previously, or when contact is intermittent, enemy is not in posession of terrain key to Blue force, or Blue force has been ordered to bypass known/ suspected positions that vicinity. At ranges >2000 meters, platoon's share of enemy force should be limited to 4 vehicles or less.
9.	2.3.	Air attack drill forced by scenario Enhancement A (Combat Air Support) or B (Attack Helicopter)
10.	3.	Platoon will bound by section to subsequent battle positions if not effectively overwatched by other friendly element.

Cmt. No.	Task No.	Comment
11.	3.	Platoon will only bound by section prior to contact or until platoon consolidates after initial contact.Force ratios portrayed preclude effective attack by single platoon. Scenario must portray larger blue force of at least company/team size.
12.	4.	Platoon may be directed to overwatch bound of sister element in Company/Team application of fire and movement. Task required in conjunction with Enhancement E if platoon is overwatching force.
13.	6.	Platoon may maneuver between firing positions while performing overwatch.
14.	7.1.	Frontal fires most likely at extended ranges (over 1000 meters), unless terrain dictates cross-fires.
15.	7.2.	Cross fires may be preferred at shorter ranges, when more vulnerable aspect (flank) of target vehicle is exposed to cross-fires.
16.	7.3.	Depth fires appropriate when scenario portrays Co/Tm frontal distribution of fires among platoons (exercised and notional).
17.	8.1.	Observed fires only appropriate when friendly vehicles outnumber targets 2:1 or better at 1000+ meters, or 4(+):1 at less than 1000 meters.
18.	8.2.	Alternating fires appropriate when Co/Tm fire distribution reduces force ratio in engagements near or above 1:1 (friendly:enemy). Decision is also range dependent—at shorter ranges, simultaneous fires would be preferred unless force ratio is 2:1 or better.